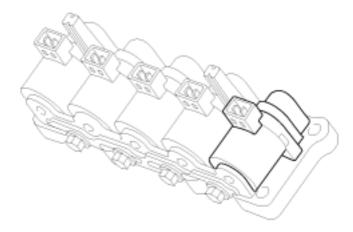
# **DESCRIPTION**

Component Location: 24 brake control solenoid valve (PCSV-B) is attached to the valve body.



Function: Control the 24 brake or reverse clutch hydraulic pressure to the pressure control valve for shift control.

### **INSPECTION**

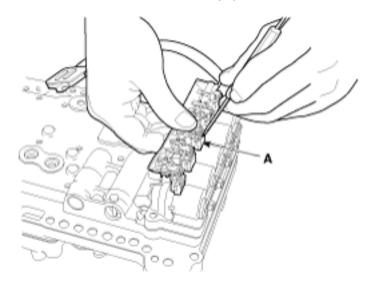
- 1. Turn ignition switch OFF.
- Remove the air cleaner.
   (Refer to Engine Mechanical System "Air cleaner")
- 3. Disconnect the solenoid valve connector (A).



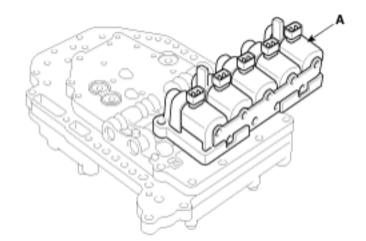
- 4. Measure resistance between signal terminal and ground terminal.
- 5. Check that the resistance is within the specification.

# **REMOVAL**

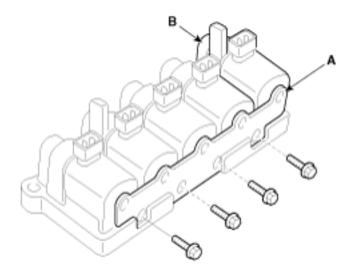
- Remove the valve body assembly.
   (Refer to Hydraulic System "Valve Body")
- 2. Remove the main harness (A) from the solenoid valve.



3. Remove the solenoid valve assembly (A) from the valve body.



4. Remove the 24 brake control solenoid valve (B) after removing the bracket (A).

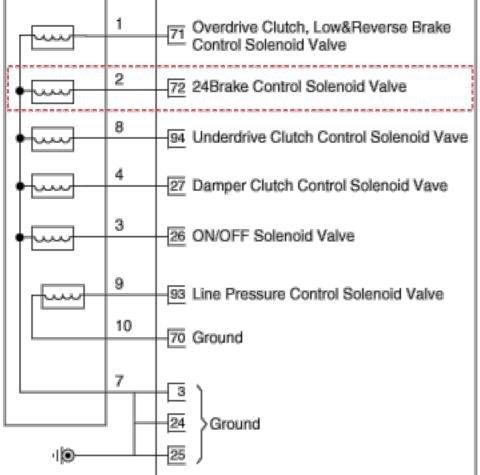


# **INSTALLATION**

1. Install in the reverse order of removal.

# Solenoid Valve

### TCM



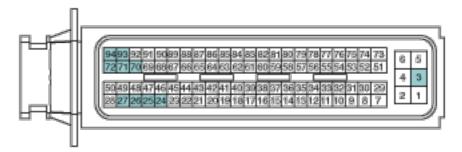
### [Connection Information]

Terminal	Connected to	Function
1	TCM (71)	Overdrive Clutch, Low&Reverse Brake Control Solenoid Valve
2	TCM (72)	24Brake Centrel Solenoid Valve
3	TCM (26)	ON/OFF Solenoid Valve
4	TCM (27)	Damper Clutch Control Solenoid Vave
7	TCM (3)	Ground
8	TCM (94)	Underdrive Clutch Control Solenoid Vave
9	TCM (93)	Line Pressure Control Solenoid Valve
10	TCM (70)	Ground

### [Harness Connector]



Solenoid Valve



TCM Connector

# **SPECIFICATION**

Control type : Normal open 3-way, PWM

Operating temperature	(-30~130°C) -22~226 °F
Current	750mA Max.
Internal resistance	3.2 ± 0.2 Ω [25°C(77 °F)]

### **INSPECTION**

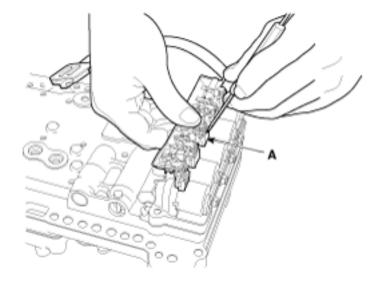
- 1. Turn ignition switch OFF.
- Remove the air cleaner. (Refer to Engine Mechanical System - "Air cleaner")
- 3. Disconnect the solenoid valve connector (A).



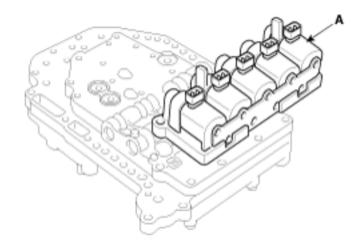
- 4. Measure resistance between signal terminal and ground terminal.
- 5. Check that the resistance is within the specification.

# **REMOVAL**

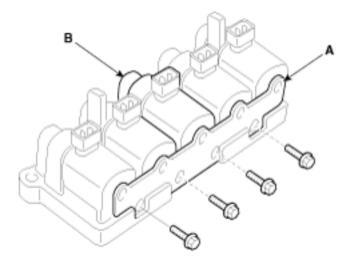
- Remove the valve body assembly. (Refer to Hydraulic System - "Valve Body")
- 2. Remove the main harness (A) from the solenoid valve.



3. Remove the solenoid valve assembly (A) from the valve body.



4. Remove the damper clutch control solenoid valve (B) after removing the bracket (A).



# **INSTALLATION**

1. Install in the reverse order of removal.

# Solenoid Valve 1 Overdrive Clutch, Low&Reverse Brake Control Solenoid Valve 2 72 24Brake Control Solenoid Valve 8 94 Underdrive Clutch Control Solenoid Vave 4 27 Damper Clutch Control Solenoid Vave 3 26 ON/OFF Solenoid Valve 9 93 Line Pressure Control Solenoid Valve 10 70 Ground

Ground

25

### [Connection Information]

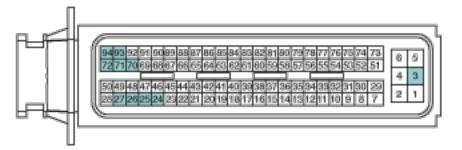
Terminal	Connected to	Function
1	TCM (71)	Overdrive Clutch, Low&Reverse Brake Control Solenoid Valve
2	TCM (72)	24Brake Control Solenoid Valve
3	TCM (26)	ON/OFF Solenoid Valve
4	TCM (27)	Damper Clutch Control Solenoid Vave
7	TCM (3)	Ground
8	TCM (94)	Underdrive Clutch Control Solenoid Vave
9	TCM (93)	Line Pressure Control Solenoid Valve
10	TCM (70)	Ground

### [Harness Connector]

1**9** 



Solenoid Valve



TCM Connector

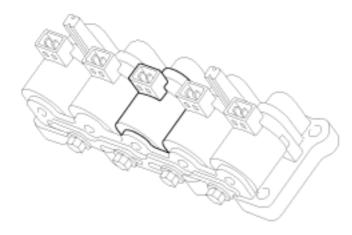
# **SPECIFICATION**

Control type: Normal open 3-way, PWM

Operating temperature	(-30~130°C) -22~226 °F
Current	750mA Max.
Internal resistance	3.2 ± 0.2 Ω [25°C(77 °F)]

# **DESCRIPTION**

Component Location: Damper clutch control solenoid valve (PCSV-D) is attached to the valve body.

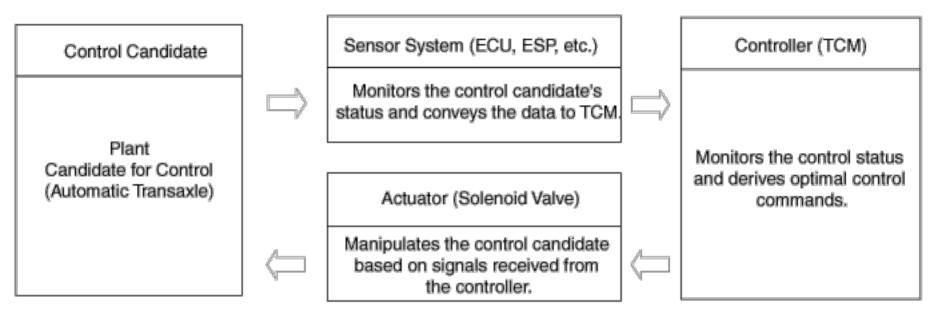


Function: Control the hydraulic pressure for the damper clutch control

### **DESCRIPTION**

Automatic transaxle system relies on various measurement data to determine the current control status and extrapolate the necessary compensation values. These values are used to control the actuators and achieve the desired control output. If a problem with the drive train, including the transaxle, has been identified, perform self-diagnosis and basic transaxle inspection (oil and fluid inspection) and then check the control system's components using the diagnosis tool.

### **Control System Composition**



### Fault Diagnosis

Features a fail-safe mechanism that provides "limp-home" 3rd gear hold to enable the vehicle to be driven to the owner's home or dealer shop.

Fail-Safe: The TCM provides 3rd gear hold and Reverse gear in the event of a malfunction.

Limp Home: Maintains minimal functionality (Drive(3rd gear hold), Reverse) in the event of a malfunction, making it possible for the vehicle to reach the dealer shop.

## Self-diagnosis

TCM is in constant communication with the control system's components (sensors and solenoid). If an abnormal signal is received for longer than the predefined duration, TCM recognizes a fault, stores the fault code in memory, and then sends out a fault signal through the self-diagnosis terminal. Such fault codes are independently backed up and will not be cleared even if the ignition switch is turned off, the battery is disconnected, or the TCM connector is disconnected.

# i Information

Disconnecting a sensor or an actuator connector while the ignition switch is in the "On" position generates a diagnostic trouble code (DTC) and commits the code to memory. In such event, disconnecting the battery will not clear the fault diagnosis memory. The diagnosis tool must be used to clear the fault diagnosis memory.

### NOTICE

- Before removing or installing any part, read the diagnostic trouble codes and then disconnect the battery negative (-) terminal.
- Before disconnecting the cable from battery terminal, turn the ignition switch to OFF. Removal or connection of the battery cable during engine operation or while the ignition switch is ON could cause damage to the TCM.
- When checking the generator for the charging state, do not disconnect the battery '+' terminal to prevent the ECM from damage due to the voltage.
- · When charging the battery with the external charger, disconnect the vehicle side battery terminals to prevent

damage to the TCM.

### Checking Procedure (Self-diagnosis)

# i Information

When battery voltage is excessively low, Diagnostic Trouble Codes(DTC) can not be read. Be sure to check the battery for voltage and the charging system before starting the test.

### Inspection Procedure (Using the GDS)

- 1. Turn OFF the ignition switch.
- 2. Connect the GDS to the data link connector on the lower crash pad.
- 3. Turn ON the ignition switch.
- 4. Use the GDS to check the diagnostic trouble code.
- 5. Repair the faulty part from the diagnosis chart.
- 6. Erase the diagnostic trouble code.
- 7. Disconnect the GDS.

### NOTICE

- After replacing the automatic transaxle, use the GDS to reset (erase the TCM learning values). Then
  perform Transaxle Control Module (TCM) learning to provide optimum shift quality.
  (Refer to Automatic Transaxle Control System "Repair procedures")
- Adding automatic transaxle fluid.
   (Refer to Hydraulic System "Fluid")
- After servicing the automatic transaxle or TCM, clear the Diagnostic Trouble Code (DTC) using the GDS tool.
  - Diagnostic Trouble Codes (DTC) cannot be cleared by disconnecting the battery.

# **DESCRIPTION**

### Component Location: Transaxle case



### **Functions**

- Detect the input shaft rotation at the overdrive clutch & revers brake retainer side to control oil pressure when shifting.
- Feedback control, clutch-clutch control, damper clutch control, shift range control, incorrect ratio control and sensor trouble detection signal.

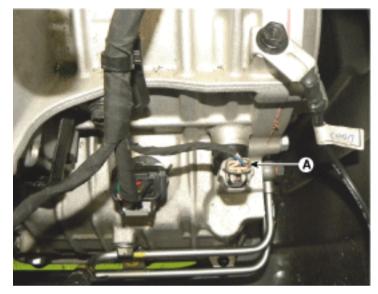
### **INSPECTION**

1. Check signal waveform of input speed sensor using the GDS

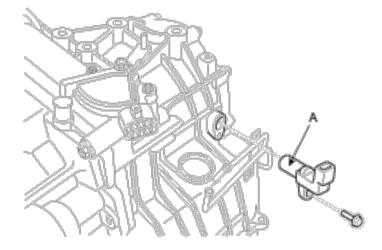
**Specification**: Refer to "Signal Wave Form" section.

### **REMOVAL**

- 1. Disconnect the negative (-) battery cable.
- Remove the air cleaner.
   (Refer to Engine Mechanical System "Air cleaner")
- 3. Disconnect the input speed sensor connector (A).



4. Remove the input speed sensor (A).



### **NOTICE**

Do not allow dust or other foreign particles to enter the transaxle after removing the input speed sensor.

### **INSTALLATION**

1. Install the new O-ring to the input speed sensor.

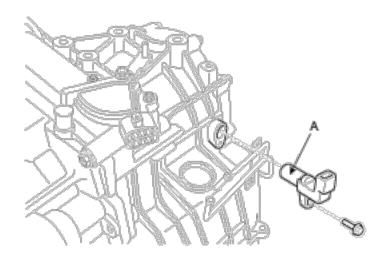
2. Install the input speed sensor (A).

### Tightening torque:

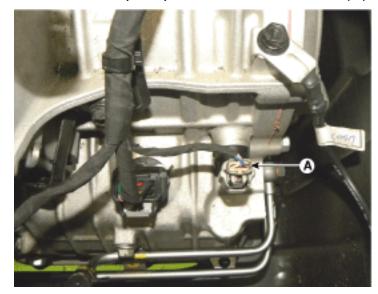
 $9.8 \sim 11.8 \text{ N.m} (1.0 \sim 1.2 \text{ kgf.m}, 7.2 \sim 8.7 \text{ lb-ft})$ 

# NOTICE

While installing the input speed sensor, do not allow dust or other foreign particles to enter the transaxle.



3. Connect the input speed sensor connector (A).



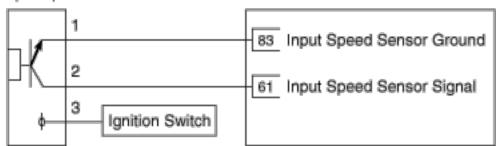
- Install the air cleaner.
   (Refer to Engine Mechanical System "Air cleaner")
- 5. Connect the negative (-) battery cable.

# [Circuit Diagram]

### [Connection Information]



TCM

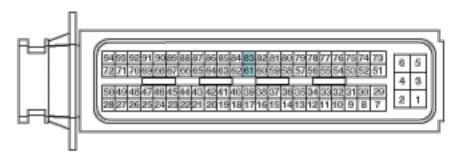


Terminal	Connected to	Function
1	TCM (83)	Ground
2	TCM (61)	Signal
3	Ignition Switch	Power

# [Harness Connector]



Input Speed Sensor Connector

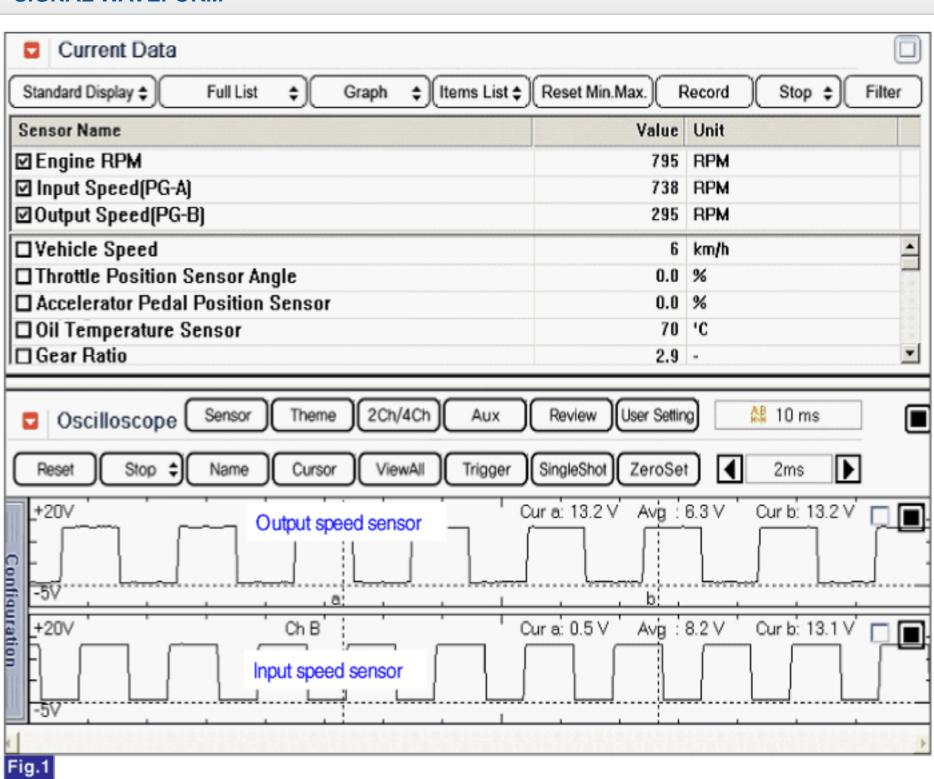


TCM Connector

# **SPECIFICATIONS**

Sensor resistance		Over 1 MΩ
Air gap(mm)in.		(1.3 )0.5118
Current consumption		22mA (Max)
Output voltage(\/)	High	Over 4.8
Output voltage(V)	Low	Below 0.8V

### **SIGNAL WAVEFORM**



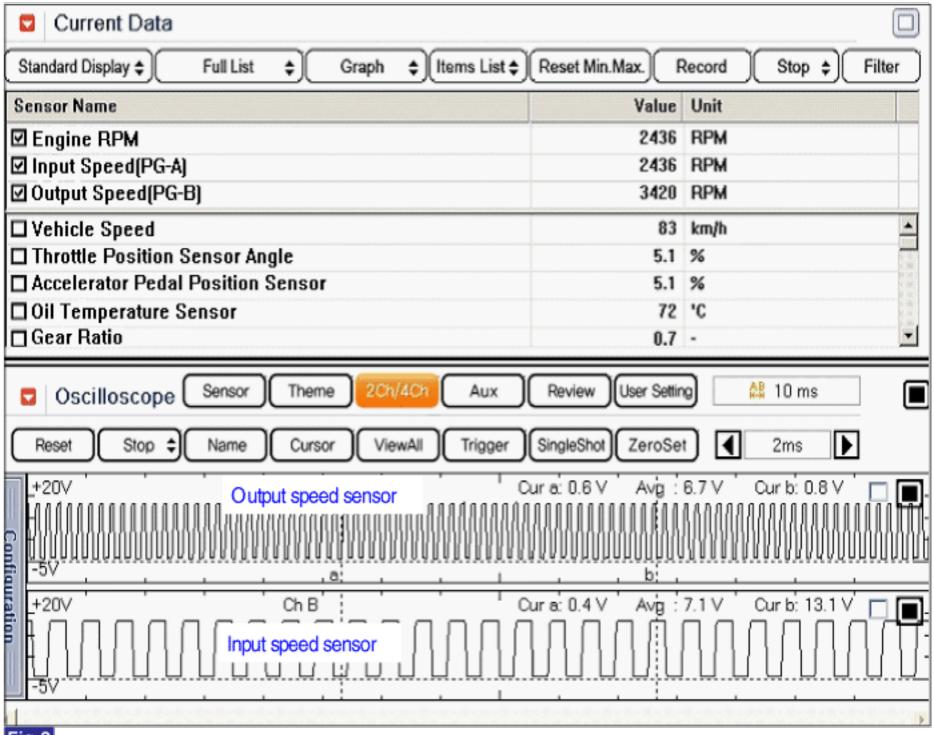


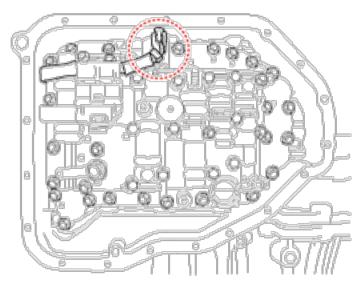
Fig.2

Fig 1) INPUT SIGNAL  $\rightarrow$  LOW SPEED

Fig 2) INPUT SIGNAL → HIGH SPEED

# **DESCRIPTION**

Component Location: Line pressure control solenoid valve is attached to the valve body.



### **Functions**

- Line pressure control solenoid valve directly controls the hydraulic pressure inside the line pressure.
- The amount of oil flow is determined by current signal for maintaining constant line pressure.

# **INSPECTION**

- 1. Turn ignition switch OFF.
- Remove the air cleaner.
   (Refer to Engine Mechanical System "Air cleaner")
- 3. Disconnect the solenoid valve connector (A).



- 4. Measure resistance between signal terminal and ground terminal.
- 5. Check that the resistance is within the specification.

# TCM Solenoid Valve Overdrive Clutch, Low&Reverse Brake Control Solenoid Valve 2 72 24Brake Control Solenoid Valve 8 94 Underdrive Clutch Control Solenoid Vave 27 Damper Clutch Control Solenoid Vave 3 26 ON/OFF Solenoid Valve 93 Line Pressure Control Solenoid Valve 10 70 Ground 7 3 24 Ground 25 11®-

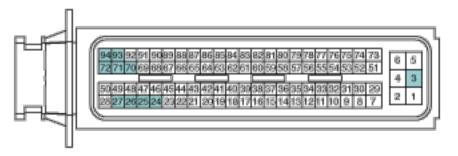
### [Connection Information]

-		-
Terminal	Connected to	Function
1	TCM (71)	Overdrive Clutch, Low&Reverse Brake Control Solenoid Valve
2	TCM (72)	24Brake Centrel Solenoid Valve
3	TCM (26)	ON/OFF Solenoid Valve
4	TCM (27)	Damper Clutch Control Solenoid Vave
7	TCM (3)	Ground
8	TCM (94)	Underdrive Clutch Control Solenoid Vave
9	TCM (93)	Line Pressure Control Solenoid Valve
10	TCM (70)	Ground

### [Harness Connector]



Solenoid Valve



TCM Connector

# **SPECIFICATION**

Direct control VFS[LINE Pressure]

Control type : Normal open 3-way

OeaigtmeaueOeaigtmeaue	(-30~130°C) -22~226 °F
Current	1.2 A Max.
Internal resistance	3.5 ± 0.2 Ω [25°C(77 °F)]

# **DESCRIPTION**

Component Location: Transaxle case



### **Functions**

- Output speed sensor : Detect the output shaft rpm(T/F DRIVEN GEAR RPM) at the T/F driven gear.
- Feedback control, clutch-clutch control, damper clutch control, shift range control, incorrect ratio control and sensor trouble detection signal.

### **INSPECTION**

1. Check signal waveform of output speed sensor using the GDS

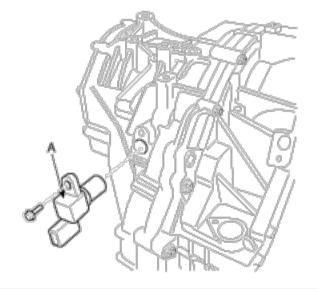
Specification: Refer to "Signal Wave Form" section.

### **REMOVAL**

- 1. Disconnect the negative (-) battery cable.
- 2. Disconnect the input speed sensor connector (A).



3. Remove the output speed sensor (A).



# NOTICE

Do not allow dust or other foreign particles to enter the transaxle after removing the output speed sensor.

### **INSTALLATION**

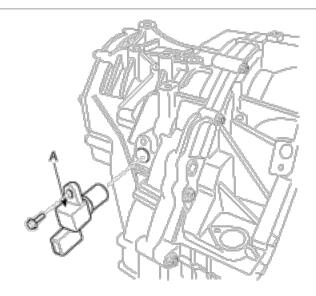
- 1. Install the new O-ring to the output speed sensor.
- 2. Install the output speed sensor (A).

Tightening torque:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

# NOTICE

While installing the output speed sensor, do not allow dust or other foreign particles to enter the transaxle.



3. Connect the output speed sensor connector (A).



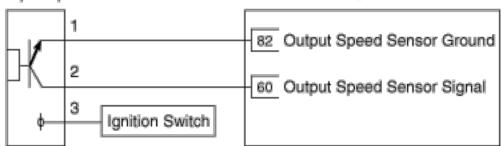
4. Connect the negative (-) battery cable.

# [Circuit Diagram]

# [Connection Information]

Output Speed Sensor

TCM

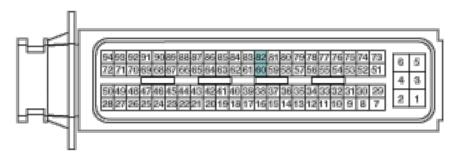


Terminal	Connected to	Function
1	TCM (82)	Ground
2	TCM (60)	Signal
3	Ignition Switch	Power

# [Harness Connector]



Output Speed Sensor Connector

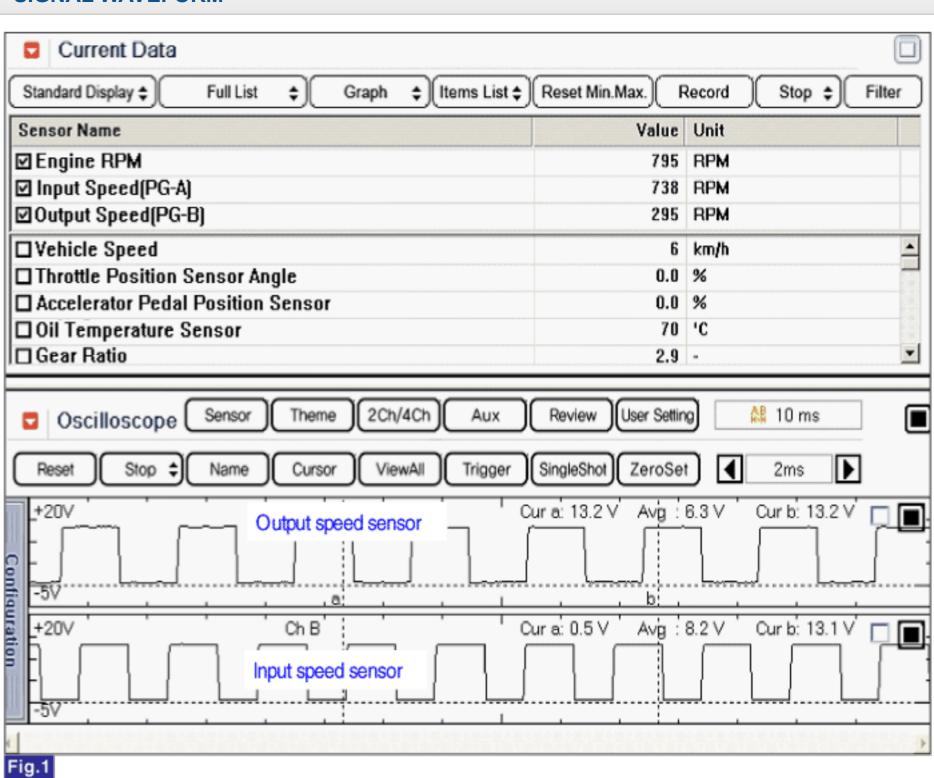


TCM Connector

# **SPECIFICATIONS**

Sensor resistance		Over 1 MΩ
Air gap(mm)in.		(0.85) 0.0335
Current consumption		22 mA (Max)
Output voltage(\( \)	High	Over 4.8
Output voltage(V)	Low	Below 0.8 V

### **SIGNAL WAVEFORM**



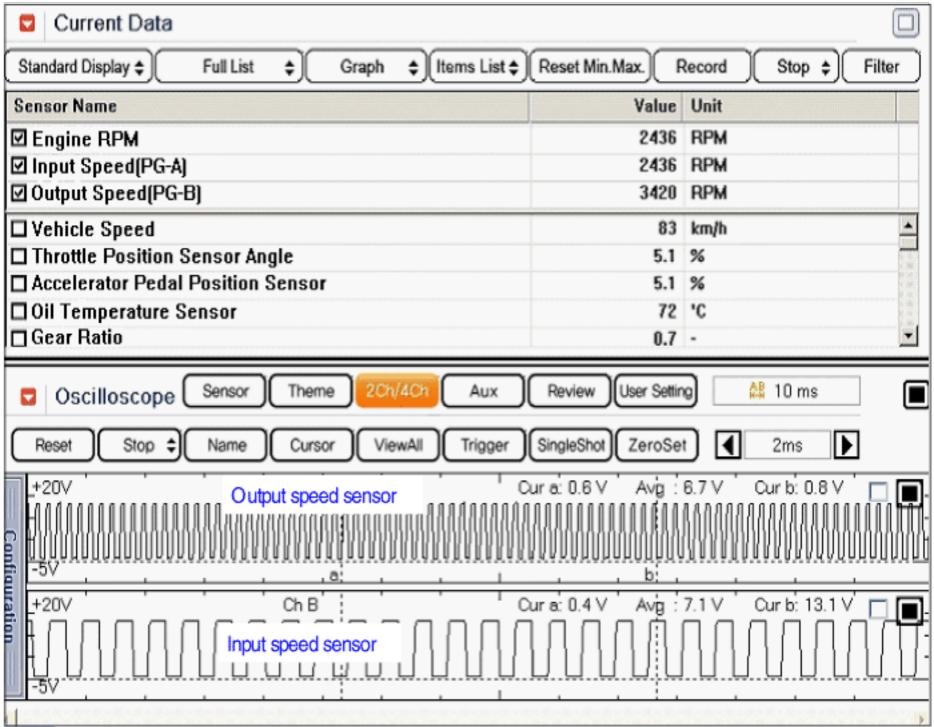


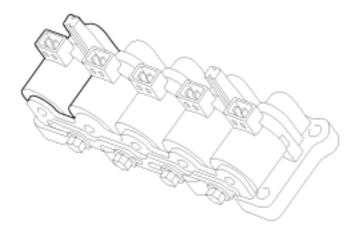
Fig.2

Fig 1) Output signal  $\rightarrow$  Low speed

Fig 2) Output signal → High speed

# **DESCRIPTION**

Component Location: Overdrive clutch control solenoid valve (PCSV-A) is attached to the valve body.



Function: Control the overdrive clutch hydraulic pressure to the pressure control valve for shift control.

### **INSPECTION**

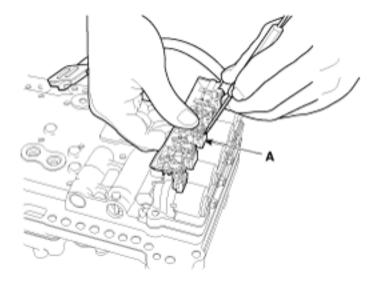
- 1. Turn ignition switch OFF.
- Remove the air cleaner. (Refer to Engine Mechanical System - "Air cleaner")
- 3. Disconnect the solenoid valve connector (A).



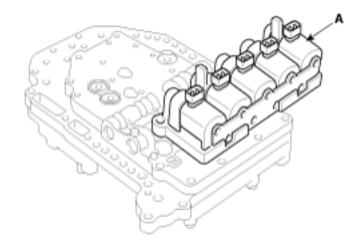
- 4. Measure resistance between signal terminal and ground terminal.
- 5. Check that the resistance is within the specification.

### **REMOVAL**

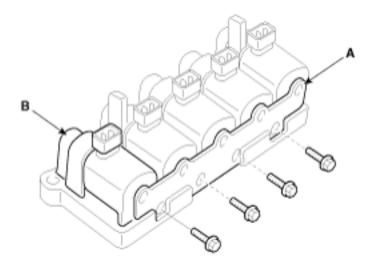
- Remove the valve body assembly. (Refer to Hydraulic System - "Valve Body")
- 2. Remove the main harness (A) from the solenoid valve.



3. Remove the solenoid valve assembly (A) from the valve body.



4. Remove the overdrive clutch control solenoid valve (B) after removing the bracket (A).

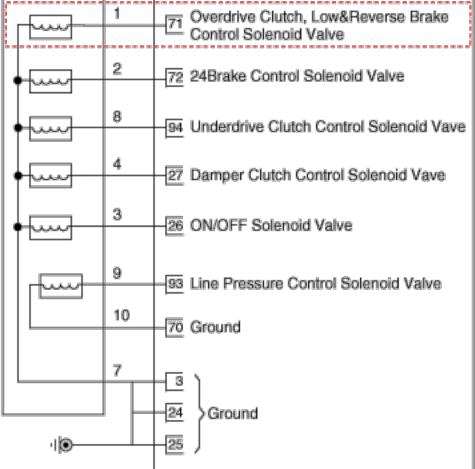


# **INSTALLATION**

1. Install in the reverse order of removal.

# Solenoid Valve

### TCM



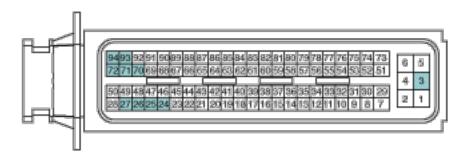
### [Connection Information]

Terminal	Connected to	Function
1	TCM (71)	Overdrive Clutch, Low&Reverse Brake Control Solenoid Valve
2	TCM (72)	24Brake Centrel Solenoid Valve
3	TCM (26)	ON/OFF Solenoid Valve
4	TCM (27)	Damper Clutch Control Solenoid Vave
7	TCM (3)	Ground
8	TCM (94)	Underdrive Clutch Control Solenoid Vave
9	TCM (93)	Line Pressure Control Solenoid Valve
10	TCM (70)	Ground

### [Hamess Connector]



Solenoid Valve



TCM Connector

# **SPECIFICATION**

Control type : Normal open 3-way

Operating temperature	(-30~130°C) -22~226 °F
Current	750mA Max.
Internal resistance	3.5 ± 0.2 Ω [25°C(77 °F)]

### **ADJUSTMENT**

### Transaxle Control Module(TCM) Learning

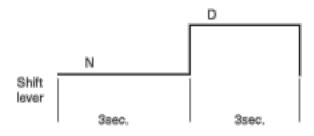
When shift shock is occurred or parts related with the transaxle are replaced, TCM learning should be performed. In the following case, TCM learning is required.

- · Transaxle assembly replacement
- TCM replacement
- TCM upgrading

# TCM learning procedure

- 1. Automatic Transaxle Fluid (ATF) temperature: 40~100°C (104~212°F)
- 2. Static learning

Repeat the below shift pattern four times or more with stepping on the brake.



- Brake ON
- Throttle open: 0%

### 3. Driving learning

Drive the vehicle from a stop in D through all gears 1st, 2nd, 3rd, 4th gear while holding the throttle steady at the specified Throttle Position Sensor (TPS) value (15~25%).

### **DESCRIPTION**

Transaxle Control Module (TCM) is the automatic transaxle's brain. The module receives and processes signals from various sensors and implements a wide range of transaxle controls to ensure optimal driving conditions for the driver

#### **Functions**

- Monitors the vehicle's operating conditions to determine the optimal gear setting.
- Performs a gear change if the current gear setting differs from the identified optimal gear setting.
- Determines the need for damper clutch (D/C) activation and engages the clutch accordingly.
- Calculates the optimal line pressure level by constantly monitoring the torque level and adjusts the pressure accordingly.
- Diagnoses the automatic transaxle for faults and failures.

#### **INSPECTION**

#### **TCM Problem Inspection Procedure**

1. TEST TCM GROUND CIRCUIT: Measure resistance between TCM and chassis ground using the backside of TCM harness connector as TCM side check point. If the problem is found, repair it.

**Specification:** below  $1\Omega$ 

- 2. TEST TCM CONNECTOR: Disconnect the TCM connector and visually check the ground terminals on TCM side and harness side for bent pins or poor contact pressure. If the problem is found, repair it.
- 3. If problem is not found in Step 1 and 2, the TCM could be faulty. If so, replace the TCM with a new one, and then check the vehicle again. If the vehicle operates normally then the problem was likely with the TCM.
- 4. RE-TEST THE ORIGINAL TCM: Install the original TCM (may be broken) into a known-good vehicle and check the vehicle. If the problem occurs again, replace the original TCM with a new one. If problem does not occur, this is intermittent problem (Refer to Intermittent Problem Procedure in Basic Inspection Procedure)

#### **REMOVAL**

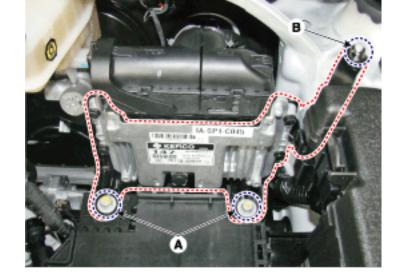
- 1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
- Remove the battery. (Refer to Engine Electrical System - "Battery")
- 3. Disconnect the TCM Connector (A).



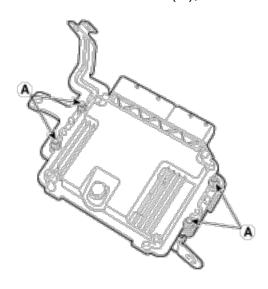
4. Remove the TCM bracket installation bolts (A) and the nut (B).

Tightening torque:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



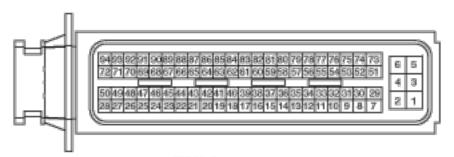
5. Remove the installation nuts (A), and then remove the ECM from the bracket.



### **INSTALLATION**

- 1. Install in the reverse order of removal.
  - Perform TCM learning after replacing the transaxle to prevent slow transaxle response, jerky acceleration and jerky startup.
    - (Refer to Automatic Transaxle Control System "Repair procedures")
  - Perform "Key teaching" procedure with GDS.
     (Refer to Body Electrical System "Immobilizer System")

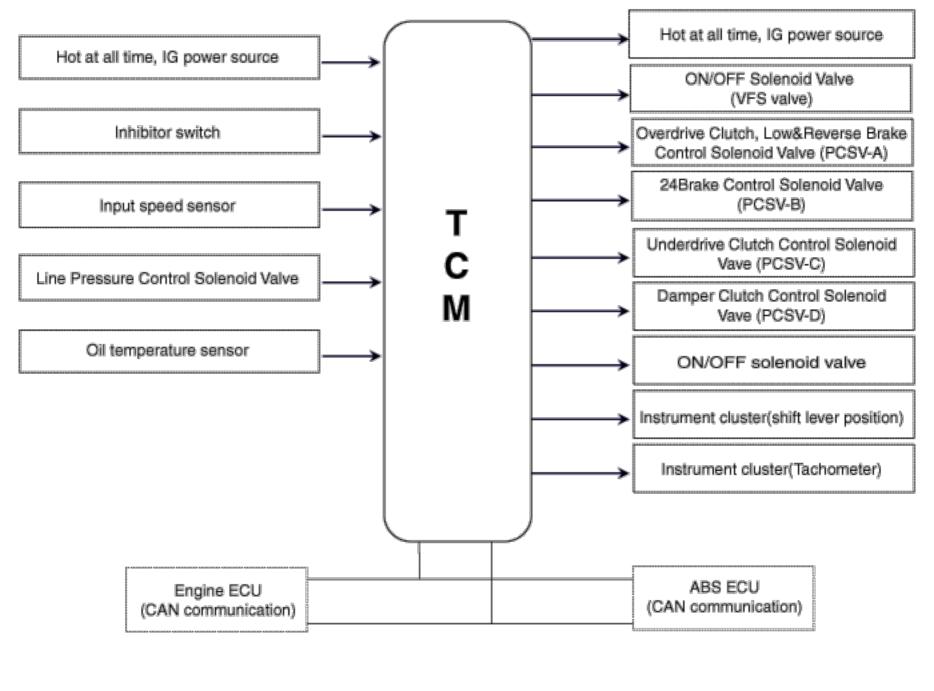
## **TCM CONNECTOR AND TERMINAL FUNCTION**



#### **TCM Connector**

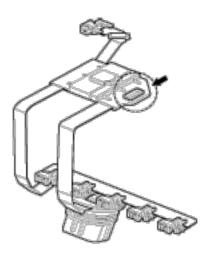
Pin	Description	Pin	Description
1	Ground output stages(ECU)	48	Gear information to meter cluster
2		49	Output vehicle speed
3	Ground electronic	50	-
4	Voltage supply for transmission (Output stages #1)	51	-
5	Voltage supply for transmission (Output stages #2)	52	-
6	-	53	-
7	-	54	
8	-	55	-
9	-	56	-
10	-	57	Oil temperature sensor (+)
11		58	
12	-	59	
13	<u>-</u>	60	Output speed sensor signal
14	-	61	Input speed sensor signal
15	-	62	
16	-	63	
17	-	64	
18	-	65	OD off request form ACC
19	-	66	Lever position D
20	-	67	Lever position P
21	-	68	Inhibitor switch L
22	-	69	
23	-	70	Ground transmission #3
24	Ground transmission #1	71	PCSV-A (Overdrive, Low & Reverse brake control valve)
25	Ground transmission #2	72	PCSV-B(24 brake control valve)
26	ON/OFF solenoid valve	73	-

27	PCSV-D (Damper clutch control solenoid valve)	74	-
28	-	75	-
29	-	76	-
30	-	77	-
31	-	78	-
32	-	79	-
33	-	80	Oil temperature sensor (-)
34	-	81	-
35	-	82	Output speed sensor ground
36	-	83	Input speed sensor ground
37	-	84	-
38	-	85	-
39	-	86	-
40	-	87	-
41	-	88	Lever position R
42	-	89	Inhibitor switch 2
43	-	90	Inhibitor switch 3
44	-	91	Lever position N
45	-	92	Ground transmission #4
46	-	93	VFS valve (Line pressure control solenoid valve)
47	Low gear information to ACC	94	PCSV-C(Underdrive clutch control valve)



### **DESCRIPTION**

Component Location: Installed on the valve body.



Oil Temperature Sensor

#### **Functions**

- Detect the temperature of ATF through the thermistor which is exposed outside.
- When shifting the range, it is used as the oil pressure control information.

#### **INSPECTION**

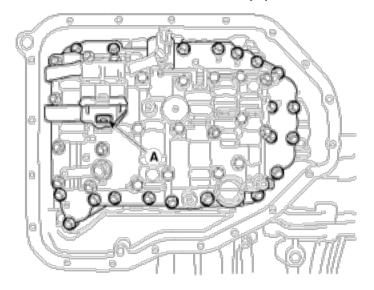
- 1. Turn ignition switch OFF.
- Remove the air cleaner.
   (Refer to Engine Mechanical System "Air cleaner")
- 3. Disconnect the solenoid valve connector (A).



- 4. Measure resistance between sensor signal terminal and sensor ground terminal.
- 5. Check that the resistance is within the specification.

#### **REMOVAL**

- Remove the valve body.
   (Refer to Hydraulic System "Valve Body")
- 2. Disconnect the main harness connector (A) from the valve body.
- 3. Disconnect the main connector (A).



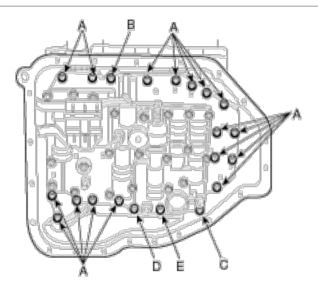
4. Remove the valve body (Bolt:21 EA).

Tightening torque:

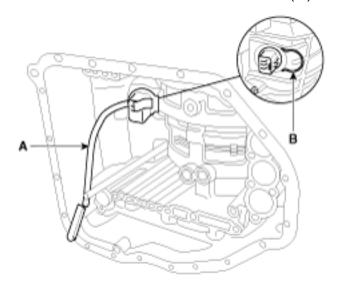
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



6×30mm(A): 17EA, 6×35mm(B): 1EA, 6×40mm(C): 1EA, 6X55mm(D):1EA, 6×60mm(E): 1EA



5. Remove the solenoid valve connector (A) after removing a clip (B).



## **INSTALLATION**

1. Install in the reverse order of removal.

### [Circuit Diagram]

Oil

temperature

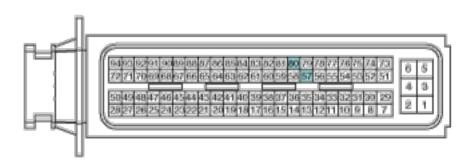
### [Connection Information]

Terminal	Connected to	Function
5	TCM (80)	Oil temperature sensor (-)
6	TCM (57)	Oil temperature sensor (+)

### [Harness Connector]







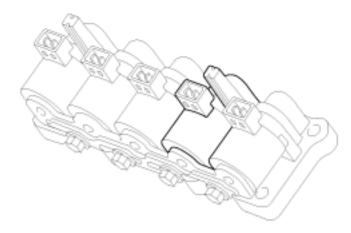
TCM Connector

# **SPECIFICATIONS**

Temp.[°C(°F)]	Resistance (KΩ)	Temp.[°C(°F)]	Resistance (KΩ)
-40(-40)	139.5	80(176)	1.08
-20(-4)	47.4	100(212)	0.63
0(32)	18.6	120(248)	0.38
20(68)	8.1	140(284)	0.25
40(104)	3.8	160(320)	0.16
60(140)	1.98		

## **DESCRIPTION**

Component Location: Underdrive clutch control solenoid valve (PCSV-C) is attached to the valve body.



Function: Control the underdrive clutch hydraulic pressure to the pressure control valve for shift control.

### **INSPECTION**

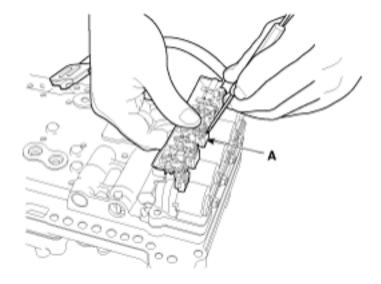
- 1. Turn ignition switch OFF.
- Remove the air cleaner.
   (Refer to Engine Mechanical System "Air cleaner")
- 3. Disconnect the solenoid valve connector (A).



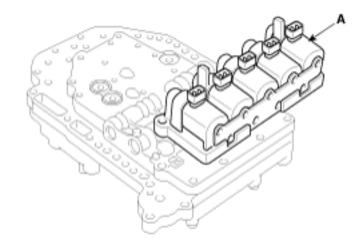
- 4. Measure resistance between signal terminal and ground terminal.
- 5. Check that the resistance is within the specification.

### **REMOVAL**

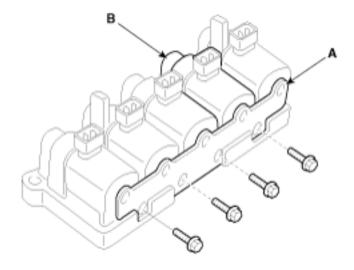
- Remove the valve body assembly.
   (Refer to Hydraulic System "Valve Body")
- 2. Remove the main harness (A) from the solenoid valve.



3. Remove the solenoid valve assembly (A) from the valve body.

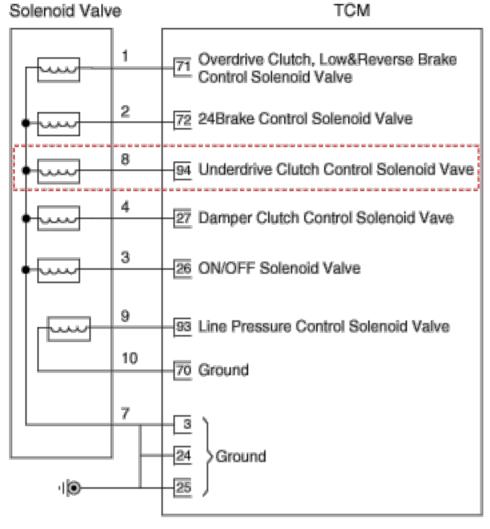


4. Remove the underdrive clutch control solenoid valve (B) after removing the bracket (A).



# **INSTALLATION**

1. Install in the reverse order of removal.



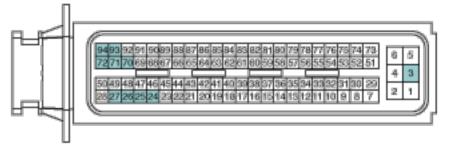
#### [Connection Information]

•					
Terminal	Connected to	Function			
1	TCM (71)	Overdrive Clutch, Low&Reverse Brake Control Solenoid Valve			
2	TCM (72)	24Brake Centrel Solenoid Valve			
3	TCM (26)	ON/OFF Solenoid Valve			
4	TCM (27)	Damper Clutch Control Solenoid Vave			
7	TCM (3)	Ground			
8	TCM (94)	Underdrive Clutch Control Solenoid Vave			
9	TCM (93)	Line Pressure Control Sciencid Valve			
10	TCM (70)	Ground			

### [Harness Connector]



Solenoid Valve

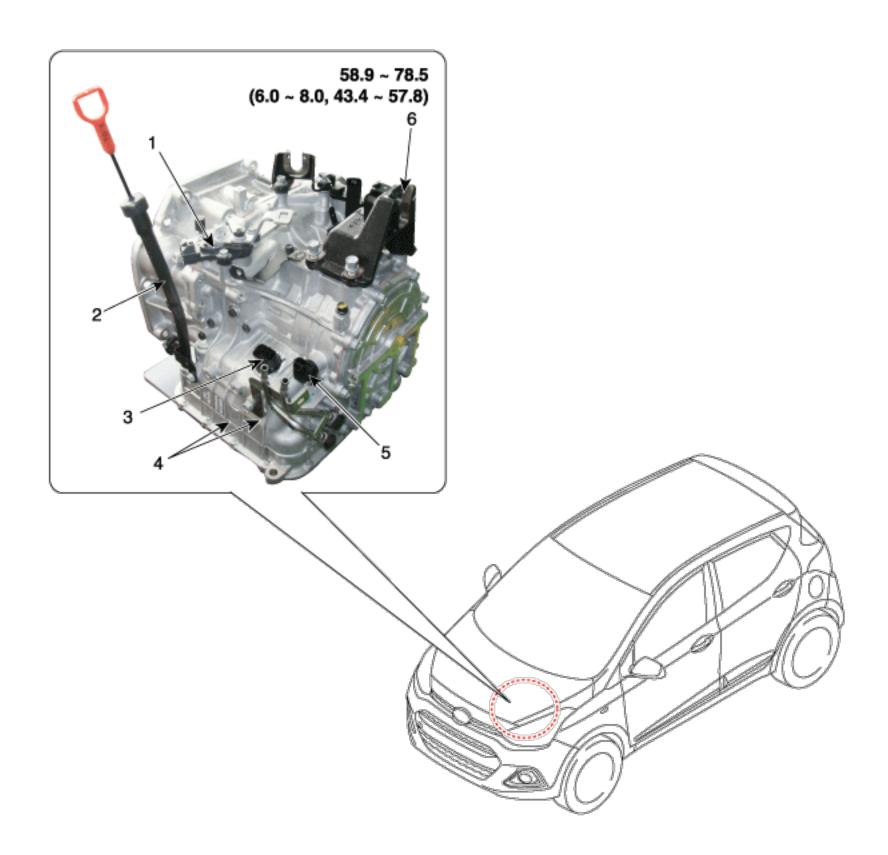


TCM Connector

# **SPECIFICATION**

Control type : Normal open 3-way, PWM

Operating temperature	(-30~130°C) -22~226 °F
Current	750mA Max.
Internal resistance	3.2 ± 0.2 Ω [25°C(77 °F)]



## Tightening torque: N.m (kgf.m, lb-ft)

- 1. Inhibitor switch
- 2. Oil level gauge
- 3. Solenoid valve connector

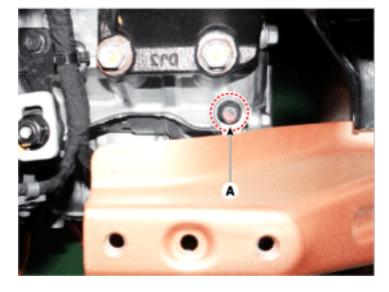
- 4. Feed tube
- 5. Input speed sensor
- 6. Transaxle support bracket

### **REMOVAL**

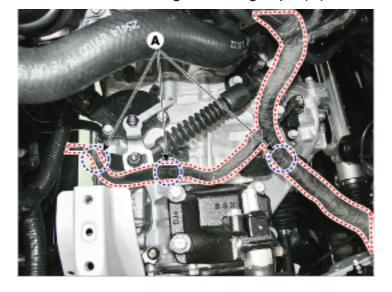
- Remove the air cleaner assembly.
   (Refer to Engine Mechanical System "Air cleaner")
- Remove the battery and battery tray. (Refer to Engine Electrical System - "Battery")
- 3. Drain the transaxle fluid.
- 4. Disconnect the solenoid valve connector (A) and the input speed sensor connector (B).



5. Remove the ground line after removing the bolt (A).



6. Disconnect the wiring mounting clips (A).



7. Disconnect the inhibitor switch connector (A).



8. Remove the shift cable (C) after removing the bolts (A) and nut (B).

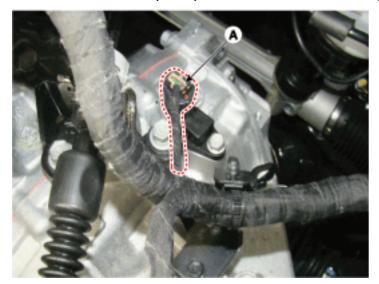
#### **Tightening torque:**

(A)  $14.7 \sim 21.6 \text{ N.m}$  (1.5 ~ 2.2 kgf.m,  $10.8 \sim 15.9 \text{ lb-ft}$ )

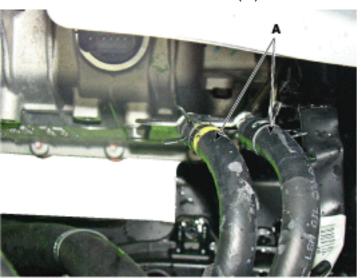
(B) 9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)



9. Disconnect the output speed sensor connector (A).



10. Disconnect the oil cooler hose (A) after removing the clamp.

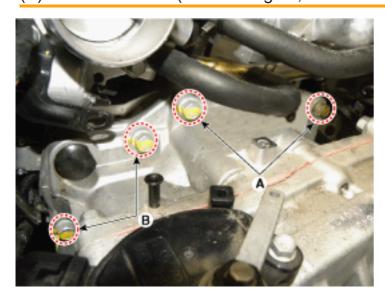


11. Remove the automatic transaxle upper mounting bolt (A-2ea) and the starter motor mounting bolt (B-2ea).

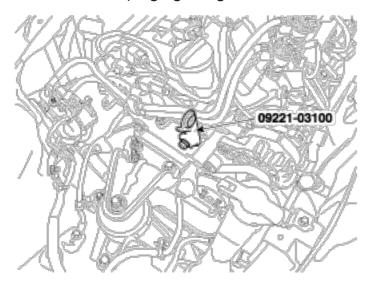
### **Tightening torque:**

(A) 58.8 ~ 78.5 N.m (6.0 ~ 8.0 kgf.m, 43.4 ~ 57.9 lb-ft)

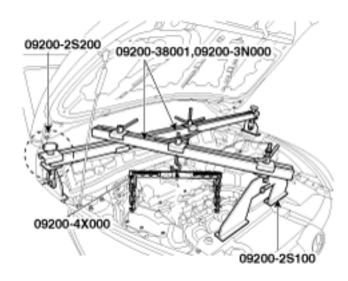
(B) 42.2 ~ 53.9 N.m (4.3 ~ 5.5 kgf.m, 31.1 ~ 39.8 lb-ft)



12. Install the SST (enging hanger SST No.: 09221-03100) on engine room.



- Remove the cowl top cover.
   (Refer to Body "Cowl Top Cover")
- 14. Assemble the engine support fixture.(Refer to Special Service Tools " Engine support fixture special tool assembly drawing")
- 15. Using the engine support fixture (beam No.: 09200-38001 or 09200-3N000, supporter No.: 09200-2S100, 09200-2S200, adapter No.: 09200-4X000), hold the engine and transaxle assembly safely.



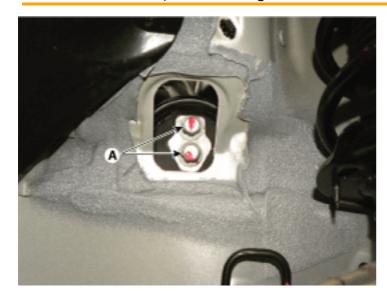
- 16. Remove the manual transaxle support bracket.
  - (1) Remove the cover (A).



(2) Remove the manual transaxle mounting bracket bolts (A).

### **Tightening torque:**

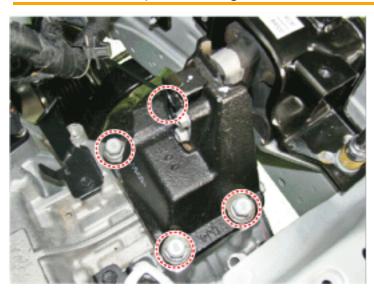
88.3 ~ 107.9 N.m (9.0 ~ 11.0 kgf.m, 65.1 ~ 79.6 lb-ft)



(3) Loosen the manual transaxle support bracket bolts.

### Tightening torque:

58.9 ~ 78.5 N.m (6.0 ~ 8.0 kgf.m, 43.4 ~ 57.8 lb-ft)

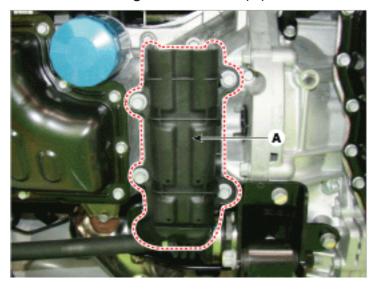


17. Remove the under cover.(Refer to Engine Mechanical System - "Engine Room Under Cover")

18. Disconnect the CKP sensor connector (A).



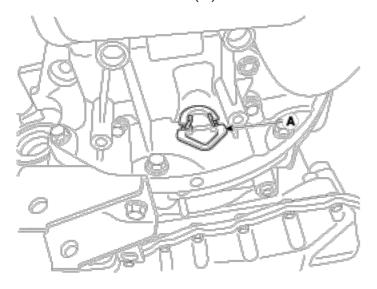
19. Remove the air guard bracket (A).



- 20. Remove the drive shaft assembly. (Refer to "Drive shaft assembly" in DS group.)
- 21. Remove the heater protector (A).



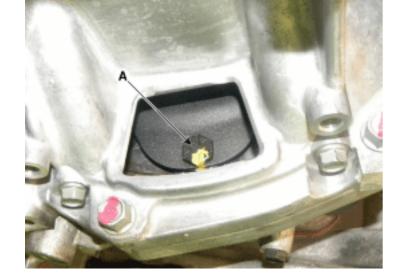
22. Remove the dust cover (A).



23. Remove the torque converter mounting bolts (A-3ea) with rotating the crankshaft.

## Tightening torque:

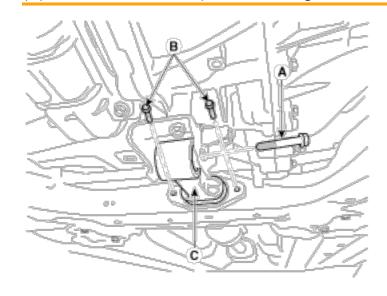
45.1 ~ 52.0 N.m (4.6 ~ 5.3 kgf.m, 33.3 ~ 38.3 lb-ft)



24. Remove the roll rod support bracket (C) after removing bolt (A,B).

### **Tightening torque:**

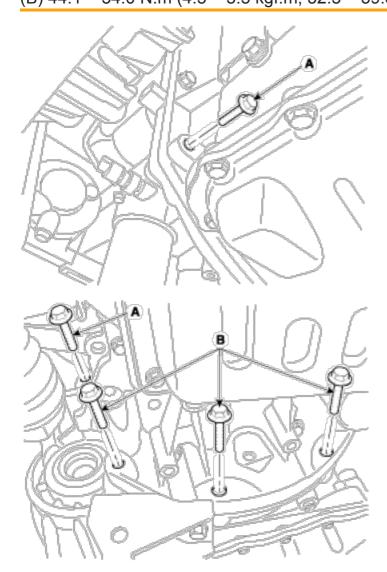
- (A)  $49.0 \sim 68.6 \text{ N.m}$  (5.0  $\sim 7.0 \text{ kgf.m}$ ,  $36.2 \sim 50.6 \text{ lb-ft}$ )
- (B) 107.9 ~ 127.5 N.m (11.0 ~ 13.0 kgf.m, 79.6 ~ 94.1 lb-ft)



25. Remove the mounting bolts (A, B) of lower part of the transaxle, and remove the transaxle assembly by supporting it with a jack.

### **Tightening torque:**

- (A) 42.2 ~ 53.9 N.m (4.3 ~ 5.5 kgf.m, 31.1 ~ 39.8 lb-ft)
- (B) 44.1 ~ 54.0 N.m (4.5 ~ 5.5 kgf.m, 32.5 ~ 39.8 lb-ft)



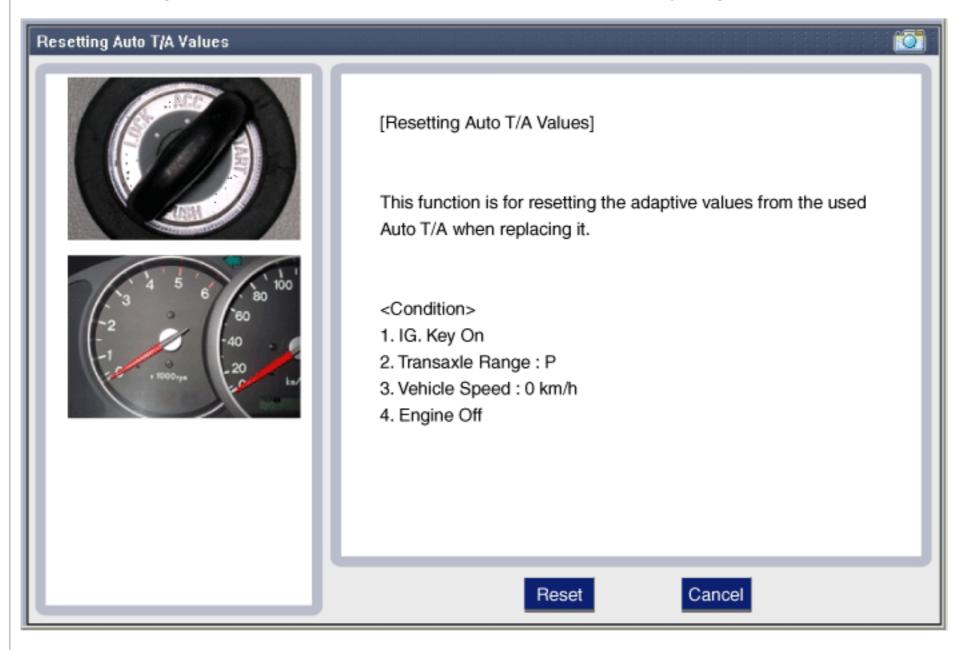
#### **INSTALLATION**

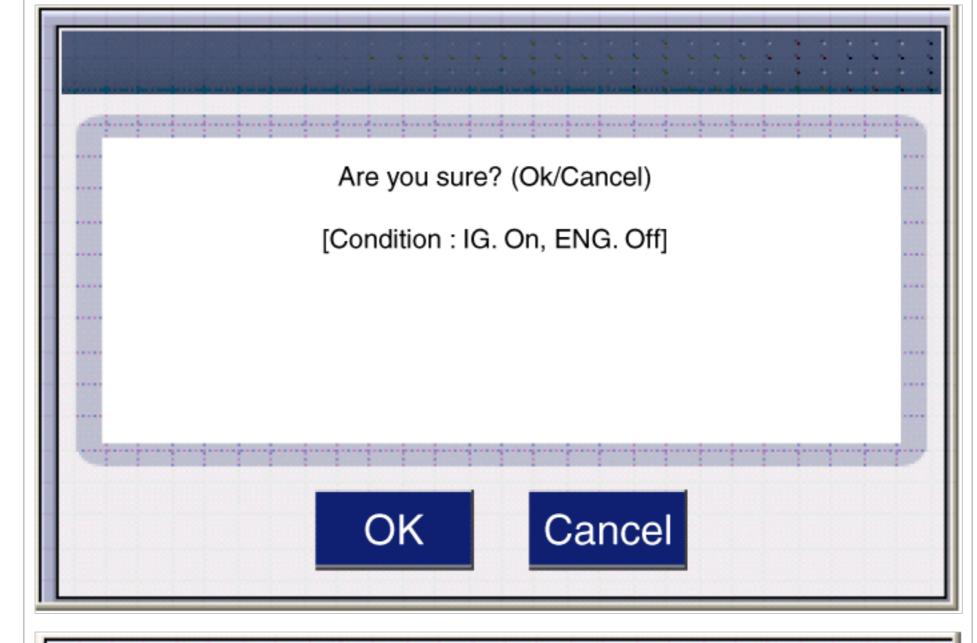
1. Install in the reverse order of removal.

### NOTICE

After replacement or reinstallation procedure of the automatic transaxle assembly, must perform procedures below.

- If the oil seal on the transaxle case side is damaged and fluid is leaking, replace the oil seal with a new unit. When installing the new oil seal, use the specialized tool (oil seal installer: 09453-2F300).
- Adding automatic transaxle fluid.
   (Refer to Hydraulic System "Fluid")
- After replacing the automatic transaxle, clear the Diagnostic Trouble Code(DTC) using the GDS tool. DTC cannot be cleared by disconnecting the battery.
- When replacing the automatic transaxle, reset the automatic transaxle's values by using the GDS.







 Perform TCM learning after replacing the transaxle to prevent slow transaxle response, jerky acceleration and jerky startup.

(Refer to Automatic Transaxle Control System - "Repair procedures")

### **REPAIR PROCEDURES**

### Torque Converter Stall Test

This test measures the maximum engine speed when the select lever is at the "D" or "R" position and the torque converter stalls to test the operation of the torque converter, starter motor and one-way clutch operation and the holding performance of the clutches and brakes in the transmission.

### **▲** CAUTION

Do not let anybody stand in front of or behind the vehicle while this test is being carried out.

- 1. Check the automatic transmission fluid level and temperature and the engine coolant temperature.
  - Fluid level: At the HOT mark on the oil level gauge
  - Fluid temperature : 80~100°C (176~212°F)
  - Engine coolant temperature : 80~100°C (176~212°F)
- 2. Check both rear wheels (left and right).
- 3. Pull the parking brake lever on, with the brake pedal fully depressed.
- 4. Start the engine.
- 5. Move the select lever to the "D" position, fully depress the accelerator pedal and take a reading of the maximum engine speed at this time.

#### NOTICE

- The throttle should not be left fully open for any more than 5 seconds.
- If carrying out the stall test two or more times, move the select lever to the "N" position and run the engine at 1,000 r/min to let the automatic transaxle fluid cool down before carrying out subsequent tests.
- Move the select lever to the "R" position and carry out the same test again.

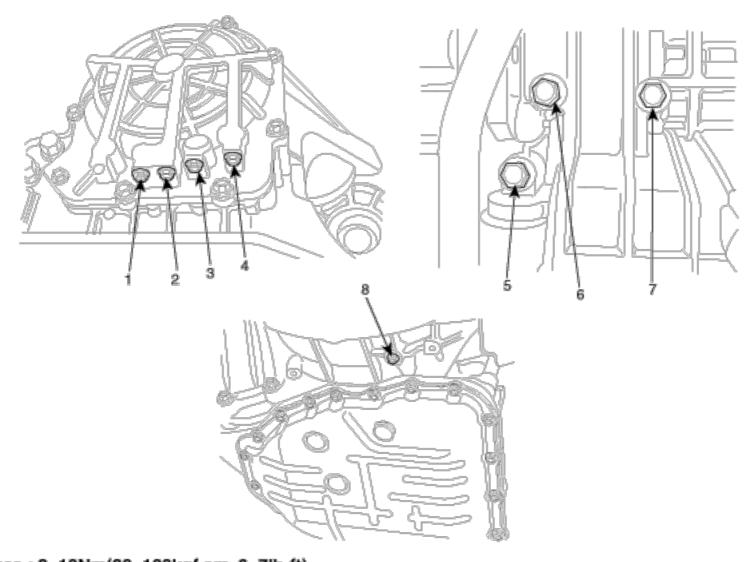
Stall rpm: 2,000~2,700 RPM

Range	Condition	Passable cause
R range slip	Reverse	REV in D range normal L/R in D range abnormal
D1 range slip D range 1st/ Sports mode 1st		L/R in reverse range abnormal UD in reverse range normal
D3 range slip 3rd gear hold		OD in 3rd gear slip (1st and 2nd gear normal)
Forwarding, reverse slip	D range, R range	Torque converter Oil pump, Manual valve in the valve Driving device abnormal

### **Hydraulic Pressure Test**

1. Warm up the engine until the automatic transaxle fluid temperature is 80~100°C(176~212°F).

- 3. Connect the special tools(09452-21500, 09452-21000, 09452-21600) oil pressure gauge to each pressure discharge
- port.
- 4. Measure the hydraulic pressure at each port under the conditions given in the standard hydraulic pressure table, and check that the measured values are within the standard value ranges.
- 5. If a value is outside the standard range, correct the problem while referring to the hydraulic pressure test diagnosis table.



Torques: 8~10Nm(80~100kgf.cm, 6~7lb-ft)

2. Jack up the vehicle so that the wheels are free to turn.

1. RED pressure port	5. DA pressure port
2. OD pressure port	6. UD pressure port
3. 2ND pressure port	7. LR pressure port
4. REV pressure port	8. DR pressure port

# Standard Hydraulic Pressure Table

No	Shift range	Operation					Oil pres			ressure (kgf/arr)		
No.	position	PC\$V-A	PCSV-B	PCSV-C	PCSV-D	ON/OFF	Measuring	LR	2/4(2ND)	ŲD	QD	REV
1	D	0	100	0	0	ON	LR	10.5±0.2	0	10.5±0.2	0	0
2	1	50	1	†	1	1	1	5.6±0.4	1	1	1	1
3	1	75	↑	↑	Î	1	1	1.0±0.3	1	↑	1	↑
4	1	100	†	†	1	1	1	0	1	†	1	1
5	<b>†</b>	1	0	†	100	OFF	2/4(2ND)	0	10.5±0.2	1	Ţ	†
6	1	†	50	†	1	<b>†</b>	<b>†</b>	†	5.3±0.4	1	†	†
7	1	1	75	†	1	1	1	1	0.9±0.3	1	1	<b>†</b>
8	1	*	100	†	1	1	1	1	0	†	1	1
9	↑	0	<b>†</b>	<b>†</b>	î	<b>†</b>	OD	↑	↑	↑	10.5±0.2	<b>†</b>
10	1	50	<b>†</b>	<b>†</b>	1	1	1	1	1	1	5.6±0.4	<b>†</b>
11	↑	75	<b>†</b>	<b>†</b>	Î	1	1	<b>†</b>	Ť	1	1.0±0.3	<b>†</b>
12	<b>†</b>	100	<b>†</b>	<b>†</b>	Î	1	1	↑	↑	1	0	<b>†</b>
13	1	1	1	0	0	Ť	UD	1	1	10.5±0.2	1	1
14	1	7	1	50	Î	Ť	†	1	1	5.6±0.4	1	Ť
15	1	↑	1	75	Î	<b>†</b>	1	↑	↑	1.0±0.3	1	<b>†</b>
16	†	0	1	100	1	1	1	1	1	0	1	<b>†</b>
17	R	1	0	†	1	ON	REV	17.7±0.8	1	†	1	17.7±0.8
18	1	<b>†</b>	50	<b>†</b>	†	<b>↑</b>	1	†	<b>†</b>	1	1	8.8±0.8
19	†	1	75	†	1	†	1	1	1	1	1	0.9±0.5
20	1	1	100	†	Î	†	†	1	1	†	1	0

#### [Measure condition]

Oil pump revolution : 2500rpm

■ LPCSV Duty ratio: 0%

Note) The oil pressure values of "0" marked on the above table must measure less than 0.1kgf/air when testing.

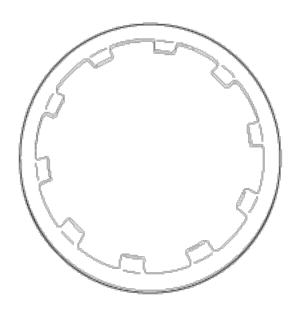
 $\ensuremath{\mathbb{X}}$  The values are subject to change according to vehicle model or condition.

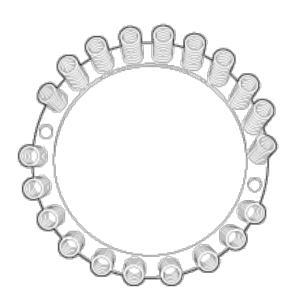
### **DESCRIPTION**

#### **Brakes**

The automatic transaxle (A4CF0) uses the low and reverse brake and the second brake. The low and reverse brake is fixed by the low and reverse annulus gear and overdrive planetary carrier.

The overdrive sun gear is held on the transaxle case by the second brake.





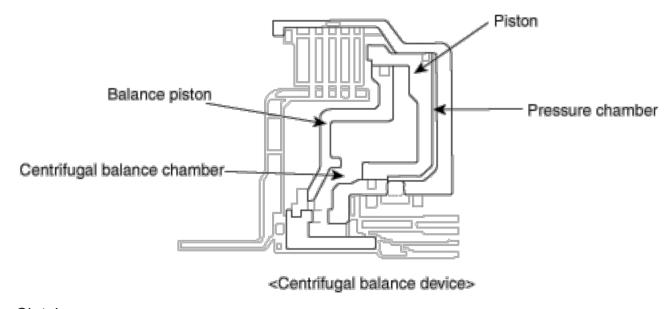
### Clutch

The multiple clutches and the one way clutch are used as the transaxle device.

The retainer of each clutch is composed of the precision sheet metal parts to realize the productivity and the light weight.

The hydraulic centrifugal oil pressure balance device places inside the clutch assembly.

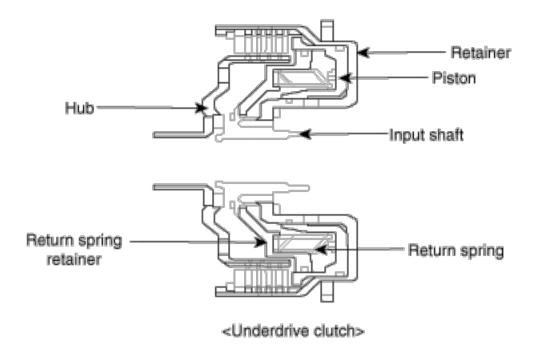
Generally the oil remained in the piston oil pressure chamber pushes the piston by the centrifugal force. But to prevent the piston from being pushed, the oil filled in between the piston and the return spring retainer occurs the centrifugal force and both of the power is offset so that the piston don't move. In result, it improves the durability and the shift control ability.



#### 1. Underdrive Clutch

The driving force of input shaft is delivered to the underdrive sun gear.

The operating oil pressure in the underdrive clutch components operates between the piston and the retainer and pushes the piston to the clutch discs to deliver the driving force from the retainer to the hub.



### 2. Reverse clutch and overdrive clutch

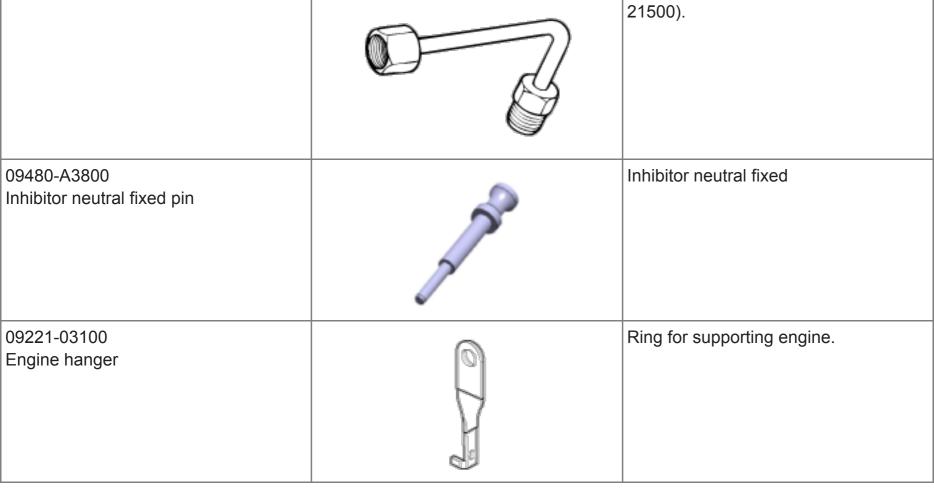
The reverse clutch delivers the driving force of input shaft to the reverse sun gear.

The overdrive clutch delivers the driving force of input shaft to the overdrive planetary carrier and the low and reverse annulus gear.

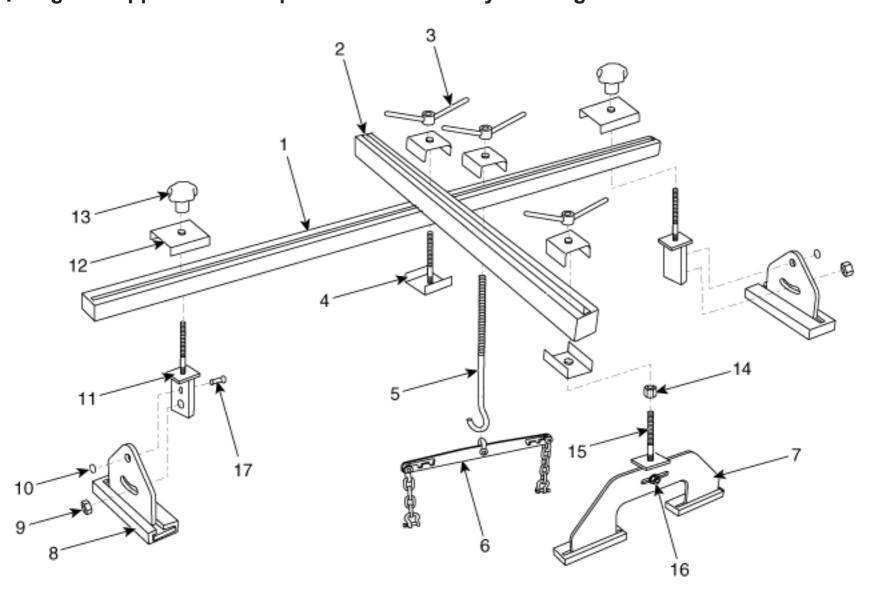
The operating oil pressure of the reverse clutch operates between the reverse clutch retainer and reverse clutch piston and it has the whole overdrive clutch moved to deliver through the hub splines.

# **SPECIAL SERVICE TOOLS**

Tool (Number and name)	Illustration	Use
09200-3N000 Engine support fixture (Beam)		Removal and installation of the transaxle. Use this adapter (SST No.: 09200-4X000) with the supporter (SST No.: 09200-2S000).  *Permit operating with 09200-38001.  *Refer to engine support fixture special tool assembly drawing below.
09200-2S000 Supporter		Removal and installation of the transaxle. Use this beam (SST No. : 09200-38001/3N000) with the adapter (SST No. :09200-4X000).
09200-4X000 Engine support fixture (Adapter)		Removal and installation of the transaxle. Use this beam (SST No. : 09200-3N000 or 38001) with the supporter (SST No. :09200-2S000). **Refer to engine support fixture special tool assembly drawing below.
09453-2F300 Oil seal installer		Installation of transaxle case oil seal.
09452-21500 Oil pressure gage		Measure the hydraulic pressure. Use this with adapter (09452-21000, 09452-21600).
09452-21000 Oil pressure gage (Adapter)		Measure the hydraulic pressure. Use this with adapter (SST No.: 09452-21600) and gage (SST No.: 09452-21500).
09452-21600 Oil pressure gage (Adapter)		Measure the hydraulic pressure. Use this with adapter (SST No.: 09452-21000) and gage (SST No.: 09452-



# \* Engine Support Fixture Special Tool Assembly Drawing



- 1. 09200-3N000 (Main bar)
- 2. 09200-3N000 (Sub bar)
- 3. 09200-3N000 (Handle)
- 4. 09200-3N000 (Stopper)
- 5. 09200-3N000 (Bolt-1)
- 6. 09200-4X000 (Adapter)

- 10. 09200-3N000 (Snap ring)
- 11. 09200-3N000 (Sub fixture)
- 10, 00000 011000 (01-----)
- 12. 09200-3N000 (Stopper)
- 13. 09200-3N000 (Nut)
- 14. 09200-2S100 (Spacer)
- 15. 09200-2S100 (Sub fixture)

7. 09200-2S100 (Supporter) 16. 09200-2S100 (Nut) 17. 09200-3N000 (Pin) 9. 09200-3N000 (Nut)

### **SPECIFICATIONS**

Ite	m	Specifications		
Transmission type		A4CF0		
Engine	e model	Gasoline 1.25		
Torque con	nverter type	3-element, 1-stage, 2-phase type		
Torque cor	nverter size	Ф210 mm (8.2677 in.)		
Oil pump	p system	Parachoid		
		Clutch: 3EA		
Friction 6	elements	Brake: 2EA		
		OWC: 1EA		
Planeta	ary gear	2EA		
	1st	2.919		
	2nd	1.551		
Gear ratio	3rd	1.000		
	4th	0.713		
	Reverse	2.480		
Final ge	ear ratio	4.336		
Fluid pressure	balance piston	2EA		
Accumulator		4EA		
Solenoi	id valve	6EA (PWM:5EA, VFS:1EA)		
Oil filter		1EA		

• PWM : Pulse Width Modulation

• VFS : Variable Force Solenoid

# Sensor

Input Speed Sensor

Sensor re	Over 1 MΩ			
Air gap(	(1.3) 0.5118			
Current co	22mA (Max)			
Output voltage(\/)	High	Over 4.8		
Output voltage(V)	Low	Below 0.8V		

Output Speed Sensor

Sensor resistance	Over 1 MΩ
Air gap(mm)in.	(0.85) 0.0335
Current consumption	22 mA (Max)

Output voltage(V)			High	Ove	er 4.8	
			Low	Belov	w 0.8 V	
Transaxle Oil Temperature Sensor  > Type : NTC (Negative Thermal Coefficient) thermister type						
Temp.[°C(°F	Res	sistance (KΩ)	Temp.[°C(°F	F)] Re	sistance (KΩ)	
-40(-40)		139.5	80(176)		1.08	
-20(-4)		47.4	100(212)		0.63	
0(32)		18.6	120(248)		0.38	
20(68)		8.1	140(284)		0.25	
40(104)		3.8	160(320)		0.16	
60(140)		1.98				
Inhibitor Switch						
Ava	ilable temperature ra	ange	-40 ~ 150°C(-40 ~ 320°F)			
	Output type			Single signaling		
Solenoid Valve  Control type : Normal open 3-way, VFS  Operating temperature  Current		(-30~130°C) -22~226 °F 1.2 A Max.				
Internal resistance		$3.5 \pm 0.2 \Omega [25^{\circ}C(77^{\circ}F)]$				
				<b>0 - 0:-</b> <u>L</u> (	. /1	
_	Solenoid Valve					
Range	PCSV-A	PCSV-B	PCSV-C	PCSV-D	ON, OFF	
N, P	OFF	ON	ON	OFF	ON	
1st	ON	ON	OFF	OFF	ON	
2nd	ON	OFF	OFF	ON	OFF	
3rd	OFF	ON	OFF	ON	OFF	
4th	OFF	OFF	ON	ON	OFF	
Reverse	OFF	OFF	ON	OFF	ON	
Information						
Item				Function		
ON/OFF (ON/OFF solenoid valve)		Control the hydraulic passage for the shift control.				

Control the overdrive clutch and low & reverse brake hydraulic

Control the 24 brake or reverse clutch hydraulic pressure to the

Control the hydraulic pressure for the damper clutch control .

pressure to the pressure control valve for shift control.

Control the underdrive clutch hydraulic pressure to the

pressure control valve for shift control.

pressure control valve for shift control.

PCSV-A(OD & L/R control solenoid valve)

PCSV-B(24 brake control solenoid valve)

PCSV-C(Underdrive clutch control solenoid valve)

PCSV-D(Damper clutch control solenoid valve)

# Tightening Torques

Item	N.m	Kgf.m	lb-ft
TCM installation mounting bolt/nut	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Input shaft speed sensor mounting bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Output shaft speed sensor mounting bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Valve body cover mounting bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil drain plug	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Control cable nut	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Retainer installation nut	8.8 ~ 13.7	0.9 ~ 1.4	6.5 ~ 10.1
Shift lever assembly bolt	8.8 ~ 13.7	0.9 ~ 1.4	6.5 ~ 10.1
Torque converter mounting bolt	45.1 ~ 52.0	4.6 ~ 5.3	33.3 ~ 38.3
Starter motor mounting bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Roll rod support bracket bolt	107.9 ~ 127.5	11.0 ~ 13.0	79.6 ~ 94.1
	49.0 ~ 68.6	5.0 ~ 7.0	36.2 ~ 50.6
Automatic transaxle upper mounting bolt	58.8 ~ 78.5	6.0 ~ 8.0	43.4 ~ 57.9
Automatic transaxle lower mounting bolt	44.1 ~ 53.9	4.5 ~ 5.5	32.5 ~ 39.8
	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Automatic transaxle support bracket bolt	58.9 ~ 78.5	6.0 ~ 8.0	43.4 ~ 57.8
Automatic transaxle bracket bolt	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Inhibitor switch mounting bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Manual control lever	16.7 ~ 20.6	1.7 ~ 2.1	12.3 ~ 15.2

## **LUBRICANTS**

# Fluid

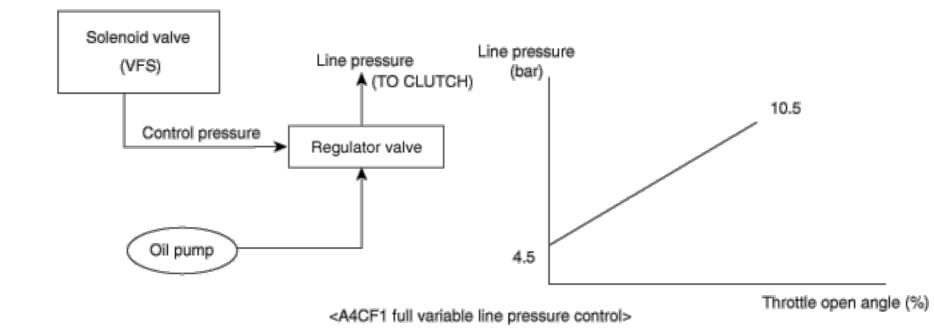
ltem	Specified lubricant	Quantity
Transaxle fluid	GENUINE DIAMOND ATF-SPIIIor SK	Gasoline1.2/1.25MPI: 6.1L
Transaxie naid	ATF- SPIII	(1.61 U.S gal., 6.45 U.S.gt., 5.36 lmp.gt.)

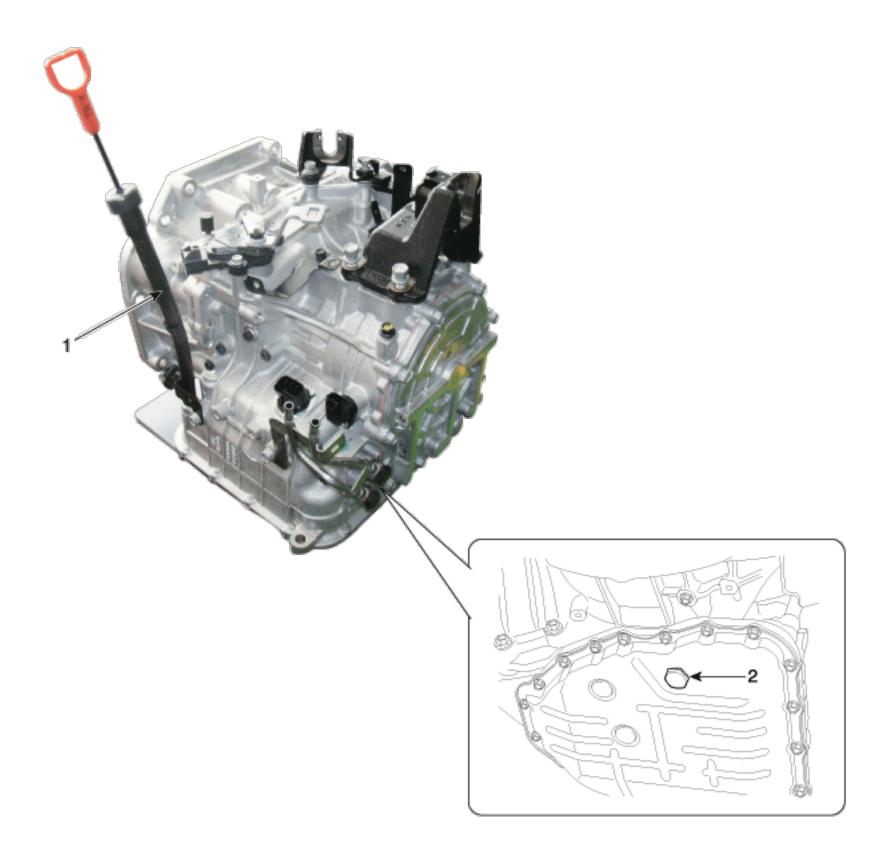
# Sealant

Item	Specified sealant
Rear cover Torque converter housing Oil pan	THREE-BOND TB1281B/1216C OR LOCTITE FMD- 5460/5480

#### **DESCRIPTION**

The hydraulic system consists of oil, an oil filter, an oil pump, and a valve body (valves and solenoid valves). The oil pump is powered by the engine. Automatic Transaxle Fluid (ATF) passes through the oil filter and gets distributed along the oil channels. The oil becomes highly pressurized as it exits the oil pump and passes through the line pressure valve before being fed to the clutch & brake control valve, clutch, and brakes. Transaxle Control Module (TCM) controls the hydraulic pressure using solenoid valves and controls clutch and brake operations.





1. Oil level gauge 2. Oil drain plug

### **GENERAL INFORMATION**

#### 1. Check & Change intervals

Check &	Chan	ge	Capacity	Oil specification	
Replenishment	Normal Use	Severe Use	Сараспу		
60000 km / 4 years (40000 miles / 4years)	No service required	100000 km 60000 miles	Gasoline1.2/1.25MPI : 6.1L (1.61 U.S gal., 6.45 U.S.qt., 5.36 Imp.qt.)	GENUINE DIAMOND ATF SP-III or SK ATF SP -III	

### 1 Information

Severe usage is defined as

- Driving in dusty, rough roads
- Driving in areas using salt or other corrosive materials or in very cold weather
- Driving in sandy areas
- Driving in mountainous areas
- Towing a trailer
- Driving for patrol car, taxi, commercial car or vehicle towing

#### **INSPECTION**

- 1. Drive the vehicle until the fluid reaches normal operating temperature [70~80°C(158~176°F)].
- 2. Place the vehicle on a level surface.

#### **NOTICE**

Inspect the oil level at idle.

- 3. Move the gear selector lever through all gear positions. This will fill the torque converter with trans fluid. Set the selector lever to the "N" (Neutral) position.
- 4. Before removing the oil level gauge, wipe all contaminants from around the oil level gauge. Then take out the oil level gauge and check the condition of the fluid.

### i Information

Fluid smells as if it is burning, it means that the fluid has been contaminated by fine particles from the brushes and friction materials, a transmission overhaul may be necessary.

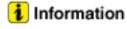
5. Check that the fluid level is in the "HOT" mark on the oil level gauge. If fluid level is low, add automatic transaxle fluid until the level reaches the "HOT" mark.

**Standard oil:** GENUINE DIAMOND ATF SP-III or SK ATF SP -III **Oil capacity:** 6.1L (1.61 U.S gal., 6.45 U.S.qt., 5.36 Imp.qt.)

#### NOTICE

Low fluid level can cause a variety of abnormal conditions because it allows the pump to take in air along with fluid. Air trapped in the hydraulic system forms bubbles, which are compressible. Therefore, pressures will be erratic, causing delayed shifting, slipping clutches and brakes, etc. Improper filling can also raise fluid level too high. When the transaxle has too much fluid, gears churn up foam and cause the same conditions which occur with low fluid level, resulting in accelerated deterioration of automatic transaxle fluid. In either case, air bubbles can cause overheating, and fluid oxidation, which can interfere with normal valve, clutch, and brake operation. Foaming can also result in fluid escaping from the transaxle vent where it may be mistaken for a leak.

#### REPLACEMENT



If you do not have a fluid changer, replace the fluid by the following procedure.

1. Disconnect the oil cooler hose (A).



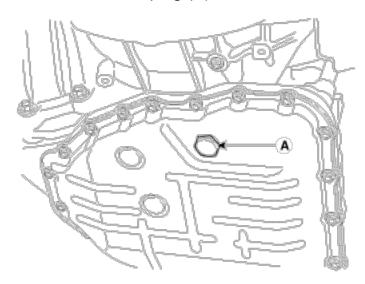
2. Start the engine and let the fluid drain out.

Running conditions: "N" range with engine idling

### NOTICE

The engine should be stopped within one minute after it is started. If the fluid has all drained out before then, the engine should be stopped at that point.

3. Remove the drain plug (A) from the bottom of the transmission case to drain the fluid.

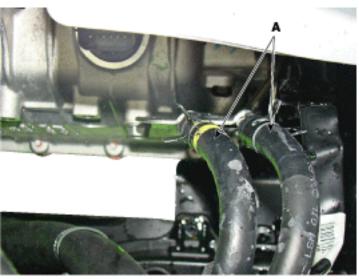


4. Install the drain plug via the gasket, and tighten it the specified torque.

### Tightening torque:

39.2 ~ 49.0 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.2 lb-ft)

5. Install the oil cooler hose (A).

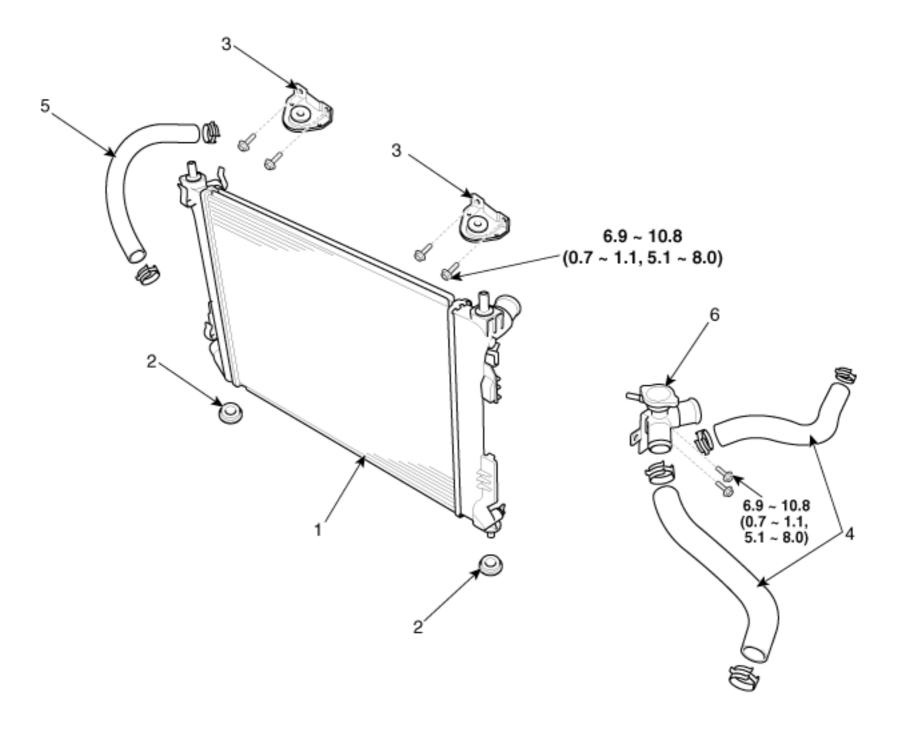


6. Pour the new fluid in through the oil filler tube.

You should be stop the pouring when if the full volume of fluid cannot be poured. Then start the engine and run it at idle for 1~2 minutes in the N or P position. Then pouring the oil after turning off the engine.

7. Drive the vehicle until the fluid temperature rises to the normal temperature (70~80°C(158~176°F)), and then check the fluid level again. The fluid level must be at the HOT mark.

### **COMPONENTS**



Torque: N.m (kgf.m, lb-ft)

1.	Rad	diator	as	sem	bl	y
_						

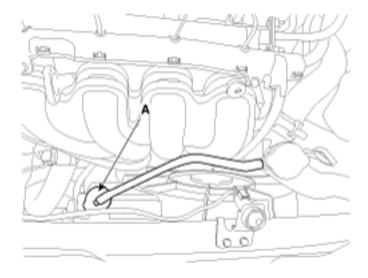
- 2. Mounting insulator
- 3. Radiator upper mounting bracket

- 4. Radiator upper hose
- 5. Radiator lower hose
- 6. Filler neck assembly

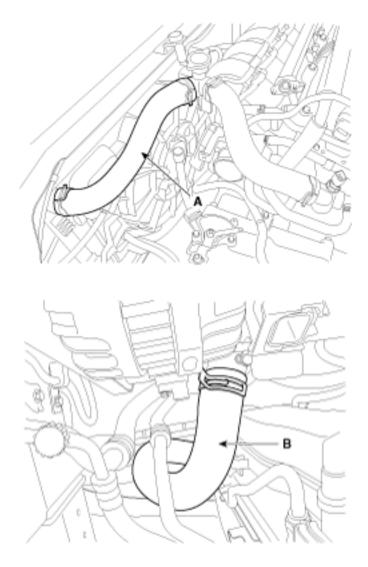
### **REMOVAL AND INSTALLATION**

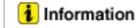
#### Radiator

- Drain the coolant.
   (Refer to Cooling System "Coolant")
- Remove the front bumper cover. (Refer to Body - "Front Bumper Cover")
- Remove the head lamps.
   (Refer to Body Electrical System "Head Lamps")
- 4. Pull out the coolant reservoir cap (A) from the reservoir tank.

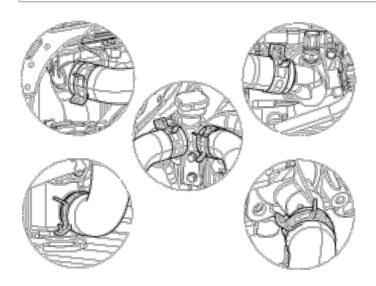


5. Remove the radiator upper hose (A) and the lower hose (B).

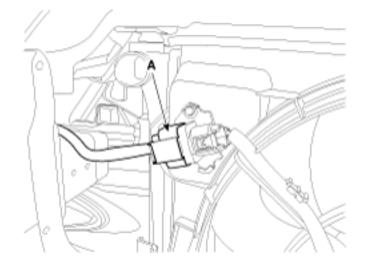




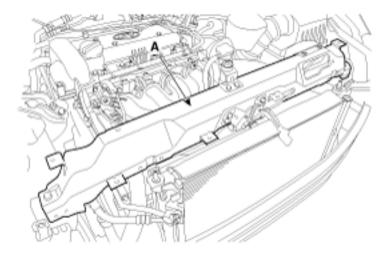
Install the radiator hoses as shown in illustrations.



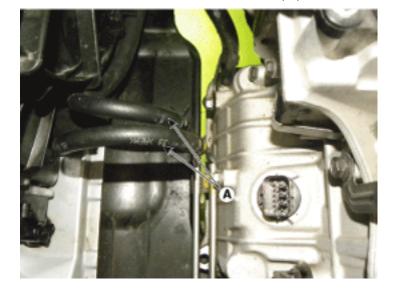
6. Disconnect the cooling fan connector (A).



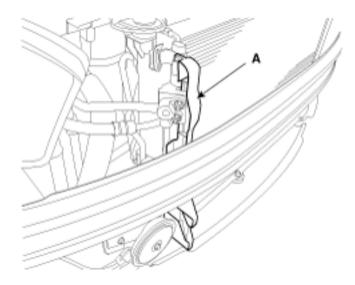
7. Remove the radiator support upper member (A).



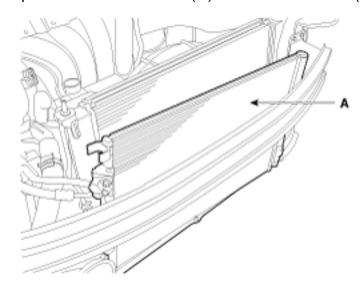
8. Disconnect the ATF cooler hoses (A).



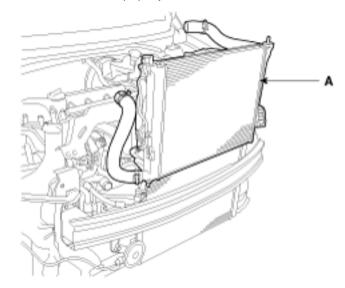
9. Remove the RH side air guard (A). (With A/C)



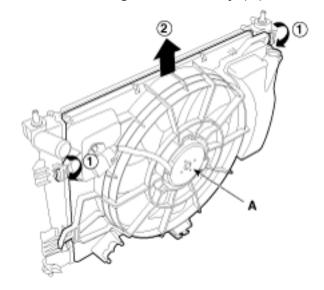
10. Separate the condenser (A) from the radiator. (With A/C)

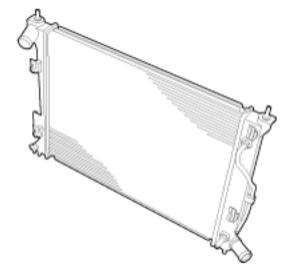


11. Pull the radiator (A) upward and remove it from engine room.



12. Remove the cooling fan assembly (A) from the radiator.





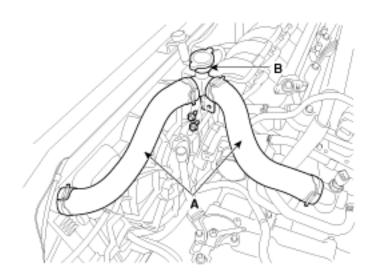
- 13. Install in the reverse order of removal.
- 14. Fill the radiator with coolant.(Refer to Cooling System "Coolant")
- 15. Start engine and check for leaks.

#### Radiator Filler Neck

- 1. Disconnect the radiator upper hoses (A).
- 2. Remove the radiator filler neck (B).

#### **Tightening torque:**

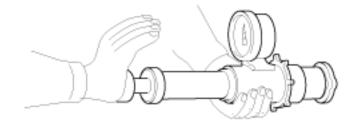
 $6.9 \sim 10.8 \text{ N.m} (0.7 \sim 1.1 \text{ kgf.m}, 5.1 \sim 8.0 \text{ lb-ft})$ 



### **INSPECTION**

### Radiator Cap

1. Remove the radiator cap, wet its seal with engine coolant, then install it no pressure tester.

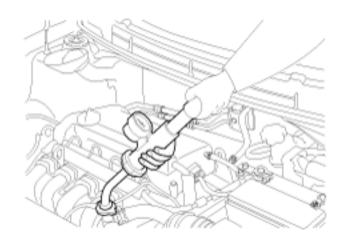


- 2. Apply a pressure of 93.16  $\sim$  122.58 kPa (0.95  $\sim$  1.25 kg/cm<sup>2</sup>, 13.51  $\sim$  17.78 psi).
- 3. Check for a drop in pressure.
- 4. If the pressure drops, replace the cap.

#### Radiator

- 1. Wait until engine is cool, then carefully remove the radiator cap.

  Fill the radiator with engine coolant, then install the pressure tester on the filler neck.
- 2. Apply a pressure of 93.16  $\sim$  122.58 kPa (0.95  $\sim$  1.25 kg/cm<sup>2</sup>, 13.51  $\sim$  17.78 psi) to the pressure tester.

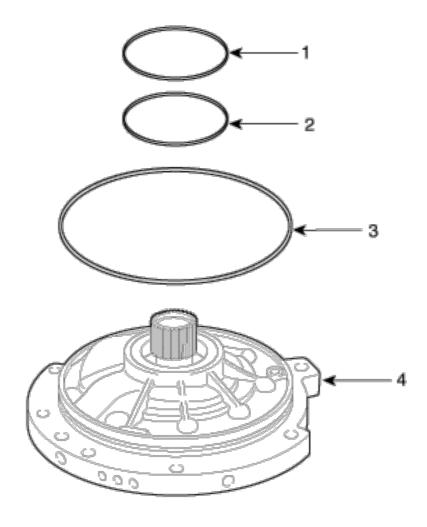


- 3. Inspect for engine coolant leaks and a drop in pressure.
- 4. If coolant leak or pressure drop is occur, replace the part.



Check for engine oil in the coolant and/or coolant in the engine oil.

### **COMPONENTS**



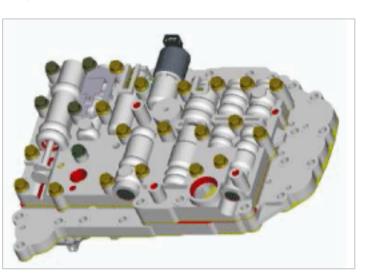
1. O-ring 2. O-ring

3. O-ring 4. Oil pump

DISCRIPTION
Rotation of the pump builds the hydraulic pressure needed for the lubrication of the various parts of the transaxle and operation of the clutch and brakes. The oil also circulates through the torque converter and the cooler.

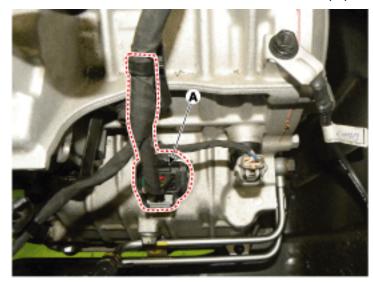
### **DESCRIPTION**

The valve body is essential to automatic transaxle control and consists of various valves used to control the oil feed from the oil pump. Specifically, these valves consist of pressure regulator valves, oil redirection valves, shift valves, and manual valves. The body also features electronic solenoid valves that ensure smooth gear changes.



#### **REMOVAL**

- 1. Disconnect the negative (-) battery cable.
- Remove the air cleaner.
   (Refer to Engine Mechanical System "Air cleaner")
- 3. Disconnect the solenoid valve connector (A).



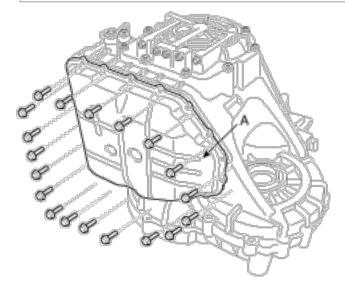
- 4. Replace new gasket and the plug after draining the automatic transaxle fluid by removing the drain plug. (Refer to Hydraulic System "Fluid")
- 5. Remove the valve body cover (A).

#### **Tightening torque:**

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

### NOTICE

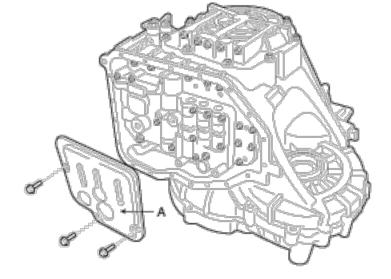
Do use the special tool (09215-3C000) in order not to damage the oil pan.



6. Remove the oil filter

#### **Tightening torque:**

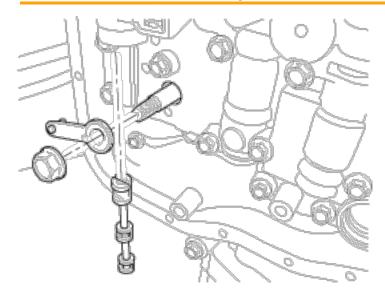
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



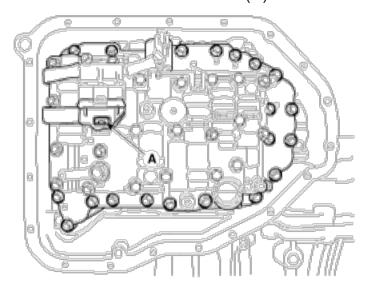
7. Remove the manual valve assembly.

### Tightening torque:

26.5 ~ 33.3 N.m (2.7 ~ 3.4 kgf.m, 19.5 ~ 24.6 lb-ft)



8. Disconnect the main connector (A).



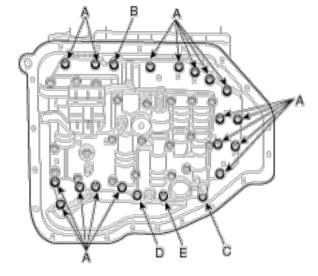
9. Remove the valve body (Bolt:21 EA).

### **Tightening torque:**

 $9.8 \sim 11.8 \text{ N.m} (1.0 \sim 1.2 \text{ kgf.m}, 7.2 \sim 8.7 \text{ lb-ft})$ 



6×30mm(A): 17EA, 6×35mm(B): 1EA, 6×40mm(C): 1EA, 6X55mm(D):1EA, 6×60mm(E): 1EA

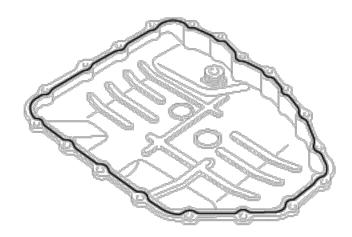


#### **INSTALLATION**

1. Install in the reverse order of removal.

### NOTICE

Apply liquid gasket with  $\emptyset$ 2.5mm (0.098in) thickness without a pause as shown in the illustration.



### Specified liquid gasket: THREE-BOND TB1281B

- Adding Automatic Transaxle Fluid(ATF).
   (Refer to Hydraulic System "Fluid")
- Perform Transaxle Control Module(TCM) learning after replacing the valve body to prevent slow transaxle response, jerky acceleration and jerky startup.
   (Refer to Automatic Transaxle Control System - "Repair procedures")

### **DESCRIPTION**

Inhibitor switch monitors the lever's position(P, R, N, D, 3, 2, L) and is used to control gear setting signals.



#### **INSPECTION**

### i Information

Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

### Power Circuit Inspection

- 1. Disconnect the Inhibitor swtich connector.
- 2. Ignition KEY "ON"" & Engine "OFF".
- 3. Measure voltage between supplied power and ground at inhibitor circuit.

Specification: Approx. 12V

### Signal Circuit Inspection

- 1. Connect the Inhibitor switch connector.
- 2. Ignition KEY "ON" & Engine "OFF".
- 3. Measure the resistance between each teminal of inhibitor switch during shift lever changed "P, R, N, D, 3, 2, L".

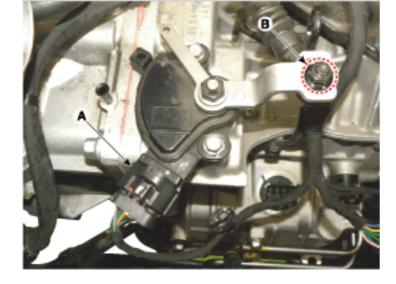
Specification: See below "Continuity Check Table"

#### **Continuity Check Table**

	Р	R	N	D	3	2	L
1	•						
6			•				
2				•			
5					•		
3						•	
4							•
8	•	•	•	•	•	•	•
7		•					
9	•		•				
10	•						

#### **REMOVAL**

- 1. Set shift lever to "N" position.
- Remove the air cleaner assembly. (Refer to Engine Mechanical System - "Air cleaner")
- Remove the battery and battery tray.(Refer to Engine Electrical System "Battery")
- 4. Disconnect the inhibitor switch connector (A) and then remove the nut (B).



- 5. Remove the manual control lever (B) and washer after removing a nut (A).
- 6. Remove the inhibitor switch mounting bolts (C).



#### **INSTALLATION**

- 1. Install the inhibitor switch.

  When installing, tighten the inhibitor assembly mounting bolts lightly, so that necessary adjustments can be made.
- 2. Install the manual lever (A) after fixing the "N" jig hole (B) using the SST(09480-A3800) or 0.1969in.(5mm) bolt.

#### **Tightening torque:**

16.7~20.6 N.m (1.7~ 2.1 kgf.m, 12.3 ~ 15.2 lb-ft)

3. Tighten the bolts (C) to specifications.

#### **Tightening torque:**

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



4. Remove the SST(09480-A3800) or 0.1969in.( 5mm) bolt.

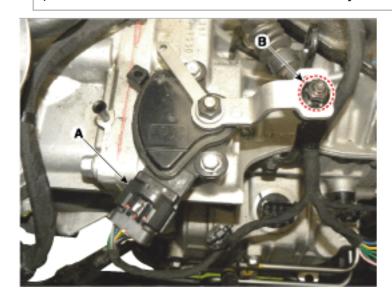
5. Connect the inhibitor switch connector (A) and then tighten the nut (B).

### Tightening torque:

9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)

### NOTICE

Adjust the shift cable before tighten the nut . (Refer to Automatic Transaxle Control System - "Shift lever")



### [Circuit Diagram]

#### Inhibitor Switch TCM Signal L input 68 3 Signal 2 input 89 5 Signal 3 input 3 90 2 Signal D input 66 8 10 91 Signal N input Ñ 9 Signal R input O-R 88 1 67 Signal P input 0 Starter

Ignition key start

Ignition key

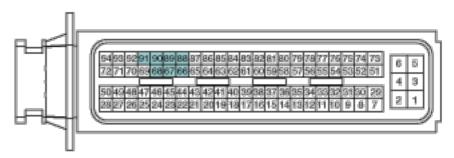
### [Connection Information]

Terminal	Connected to	Function
1	TCM (67)	Signal P input
2	TCM (66)	Signal D input
3	TCM (89)	Signal 2 input
4	TCM (68)	Signal L input
5	TCM (90)	Signal 3 input
6	TCM (91)	Signal N input
7	TCM (88)	Signal R input
8	Ignition switch	Battery voltage after ignition key on
9	Ignition switch	Battery voltage after ignition key start
10	Starter	Supply the voltage to starter

### [Harness Connector]



Inhibitor Switch Connector



TCM Connector

### **SPECIFICATIONS**

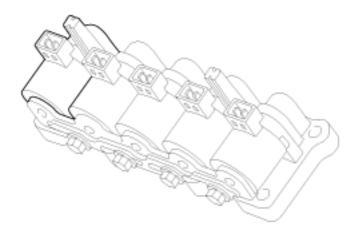
Available temperature range	-40 ~ 150°C(-40 ~ 320°F)	
Output type	Single signaling	

## 

	Р	R	N	D	3	2	L
1	•						
6			•				
2				•			
5					•		
3						•	
4							•
8		•	•	•			
7							
9	•		•				
10							

### **DESCRIPTION**

Component Location: low & reverse brake control solenoid valve (PCSV-A) is attached to the valve body.



Function: Control the low & reverse brake hydraulic pressure to the pressure control valve for shift control.

### **INSPECTION**

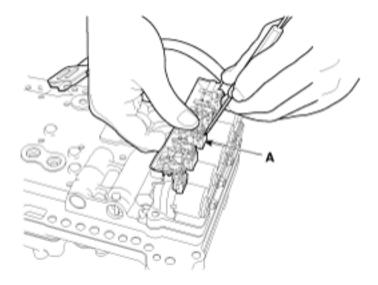
- 1. Turn ignition switch OFF.
- Remove the air cleaner.(Refer to Engine Mechanical System "Air cleaner")
- 3. Disconnect the solenoid valve connector (A).



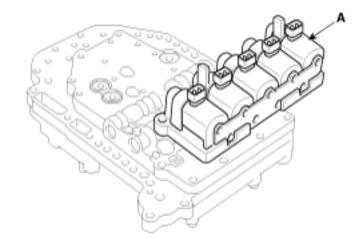
- 4. Measure resistance between signal terminal and ground terminal.
- 5. Check that the resistance is within the specification.

### **REMOVAL**

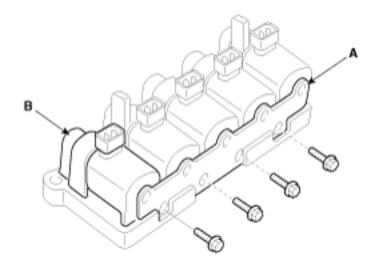
- Remove the valve body assembly. (Refer to Hydraulic System - "Valve Body")
- 2. Remove the main harness (A) from the solenoid valve.



3. Remove the solenoid valve assembly (A) from the valve body.



4. Remove the low & reverse brake control solenoid valve (B) after removing the bracket (A).



### **INSTALLATION**

1. Install in the reverse order of removal.

# Solenoid Valve Overdrive Clutch, Low&Reverse Brake Control Solenoid Valve

4

3

9

10

TCM

72 24Brake Control Solenoid Valve

26 ON/OFF Solenoid Valve

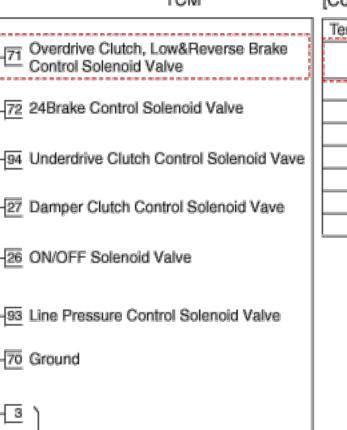
70 Ground

Ground

3

24

25



#### [Connection Information]

Terminal	Connected to	Function
1	TCM (71)	Overdrive Clutch, Low&Reverse Brake Control Solenoid Valve
2	TCM (72)	24Brake Control Solenoid Valve
3	TCM (26)	ON/OFF Solenoid Valve
4	TCM (27)	Damper Clutch Control Solenoid Vave
7	TCM (3)	Ground
8	TCM (94)	Underdrive Clutch Control Solenoid Vave
9	TCM (93)	Line Pressure Control Solenoid Valve
10	TCM (70)	Ground

#### [Hamess Connector]



Solenoid Valve



TCM Connector

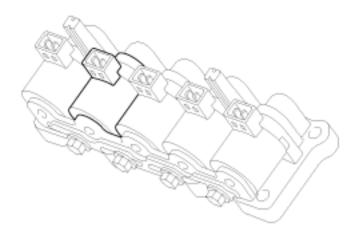
### **SPECIFICATION**

Control type : Normal open 3-way, PWM

Operating temperature	(-30~130°C) -22~226 °F		
Current	750mA Max.		
Internal resistance	3.2 ± 0.2 Ω [25°C(77 °F)]		

### **DESCRIPTION**

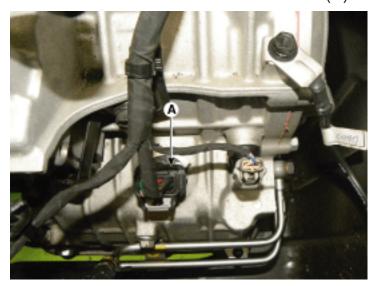
Component Location: ON/OFF solenoid valve (PCSV-A) is attached to the valve body.



Function: Control the hydraulic passage for the shift control

### **INSPECTION**

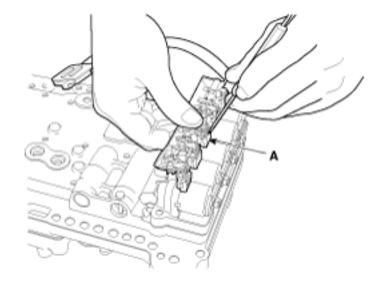
- 1. Turn ignition switch OFF.
- Remove the air cleaner.
   (Refer to Engine Mechanical System "Air cleaner")
- 3. Disconnect the solenoid valve connector (A).



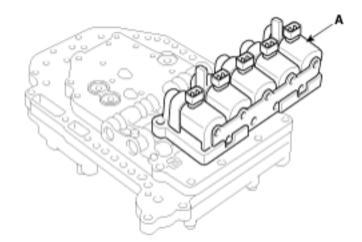
- 4. Measure resistance between signal terminal and ground terminal.
- 5. Check that the resistance is within the specification.

### **REMOVAL**

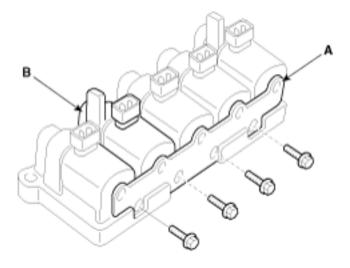
- Remove the valve body assembly. (Refer to Hydraulic System - "Valve Body")
- 2. Remove the main harness (A) from the solenoid valve.



3. Remove the solenoid valve assembly (A) from the valve body.



4. Remove the ON/OFF solenoid valve (B) after removing the bracket (A).



### **INSTALLATION**

1. Install in the reverse order of removal.

## TCM Solenoid Valve Overdrive Clutch, Low&Reverse Brake Control Solenoid Valve 2 72 24Brake Control Solenoid Valve 94 Underdrive Clutch Control Solenoid Vave 4 27 Damper Clutch Control Solenoid Vave 3 93 Line Pressure Control Solenoid Valve 10 70 Ground 7 3 24 Ground

#### [Connection Information]

<b>T</b>		E12
Termina	Connected to	Function
1	TCM (71)	Overdrive Clutch, Low&Reverse Brake Control Solenoid Valve
2	TCM (72)	24Brake Centrel Solenoid Valve
3	TCM (26)	ON/OFF Solenoid Valve
4	TCM (27)	Damper Clutch Control Solenoid Vave
7	TCM (3)	Ground
8	TCM (94)	Underdrive Clutch Control Solenoid Vave
9	TCM (93)	Line Pressure Control Solenoid Valve
10	TCM (70)	Ground

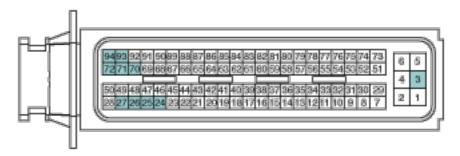
### [Hamess Connector]

4**9** 



25

Solenoid Valve

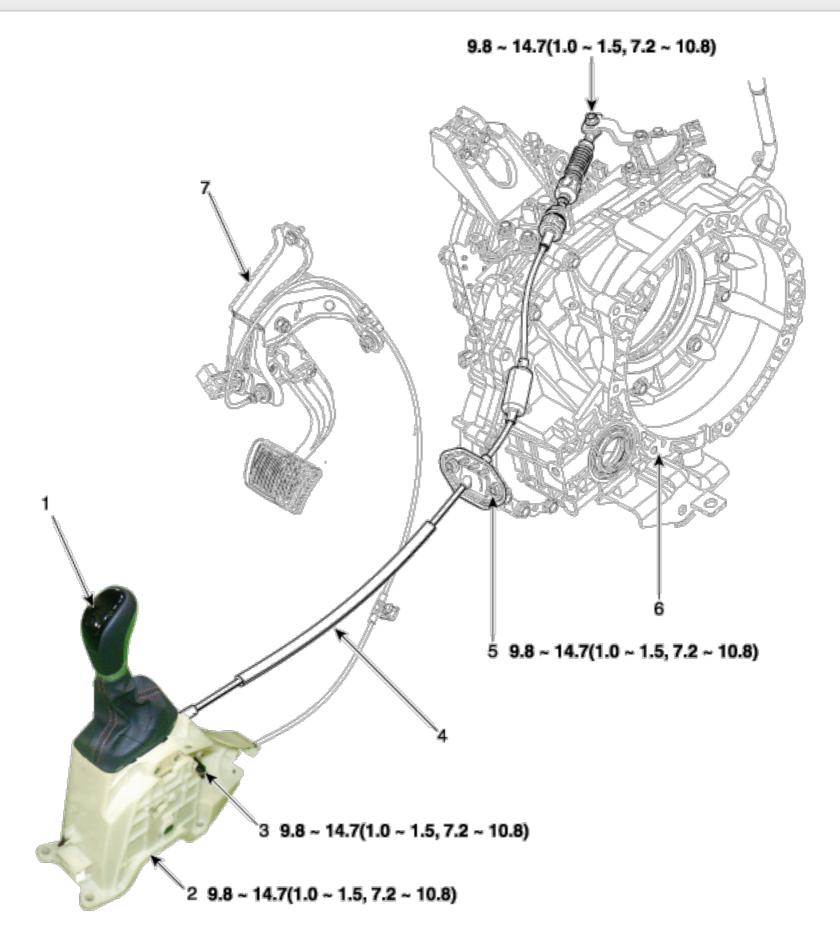


TCM Connector

### **SPECIFICATION**

Control type : Normal open 3-way

Operating temperature	(-30~130°C) -22~226 °F
Current	750mA Max.
Internal resistance	3.2 ± 0.2 Ω [25°C(77 °F)]



Tightening torque: N.m (kgf.m, lb-ft)

- 1. Knobe
- 2. Lever assembly
- 3. Shift lock cable
- 4. Shift cable

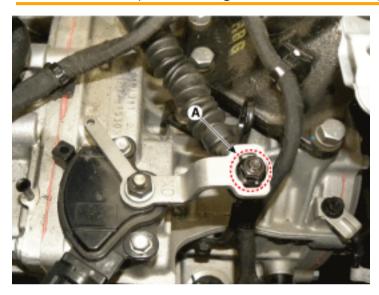
- 5. Retainer
- 6. Automatic transaxle
- 7. Brake pedal assembly

#### **REMOVAL**

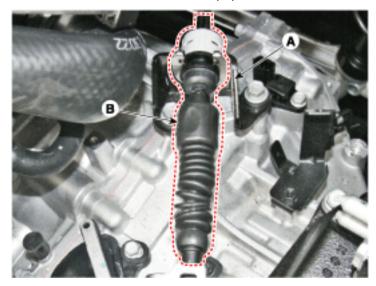
- Remove the air cleaner assembly.
   (Refer to Engine Mechanical System "Air cleaner")
- Remove the battery and battery tray. (Refer to Engine Electrical System - "Battery")
- 3. Remove the shift cable.
  - (1) Loosen the nut (A).

#### **Tightening torque:**

9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)

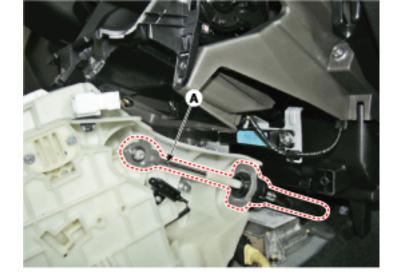


(2) Disconnect the shift cable (B) from the shift cable bracket (A).



### NOTICE

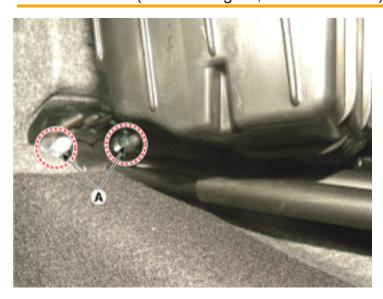
- Do not reuse the clip (A).
- Remove the floor console.
   (Refer to Body "Floor console")
- 5. Remove the shift cable (A) from the shift lever.



6. Remove the retainer after loosen the nut (A).

#### **Tightening torque:**

9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)



#### **INSTALLATION**

1. Install in the reverse order of removal.

#### NOTICE

Set shift lever and inhibitor switch manual control lever to "N" position.

#### **ADJUSTMENT**

#### Adjusting method for shift cable

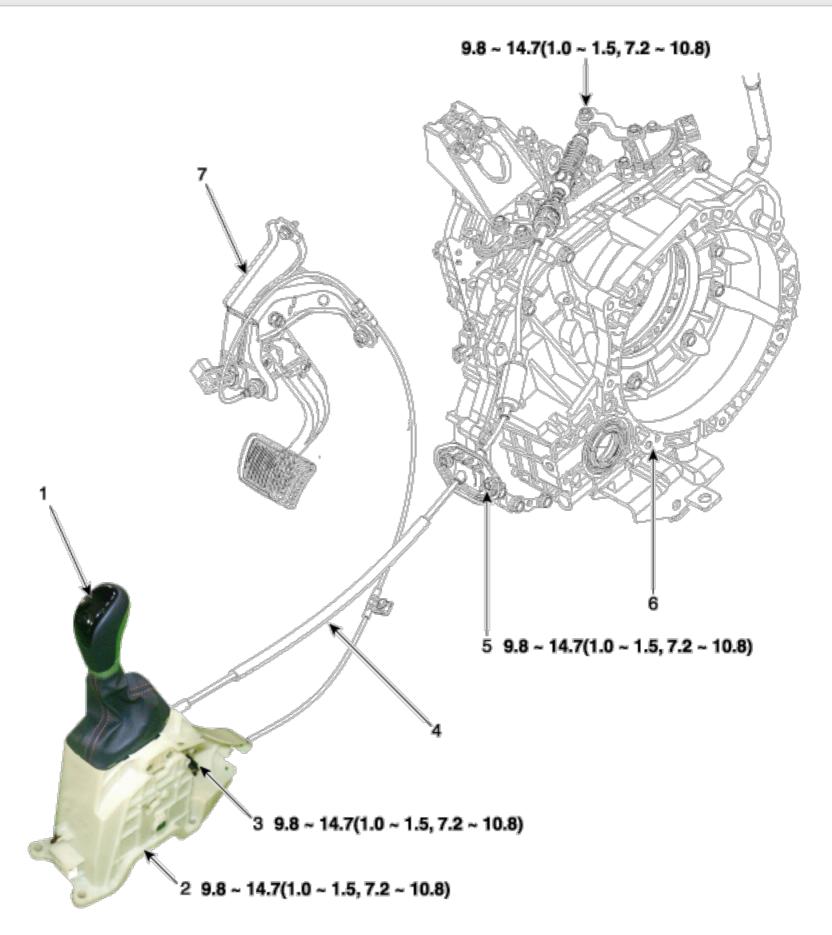
- 1. Set room side shift lever and T/M side manual control lever to "N" position.
- 2. Connect room side shift lever and shift cable.
- 3. Push cable to "F" direction shown to eliminate FREE PLAY.
- 4. Tighten adjusting nut (A).

#### **Tightening torque:**

9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)



5. After adjusting according check to be sure that this part operates surely at each range of T/M side corresponding to each position of shift lever.



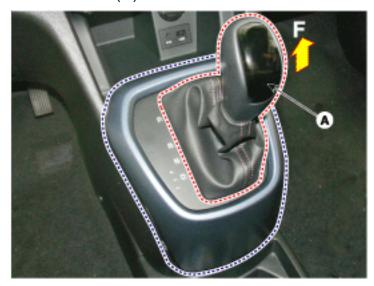
## Tightening torque: N.m (kgf.m, lb-ft)

- 1. Knobe
- 2. Lever assembly
- 3. Shift lock cable
- 4. Shift cable

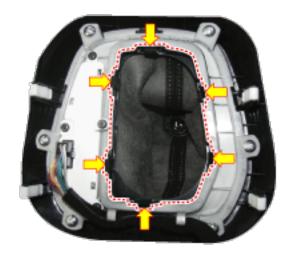
- 5. Retainer
- 6. Automatic transaxle
- 7. Brake pedal assembly

## **REMOVAL**

1. Pull the knob (A) in the direction of "F" and remove it, and then remove the console upper cover.



2. Rrmove the knob from the console upper cover after press the lock.

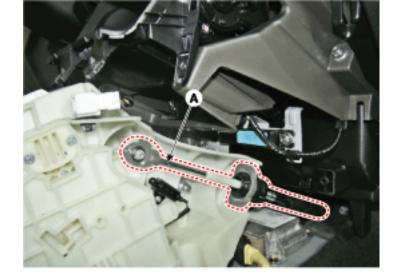


Remove the floor console. (Refer to Body - "Floor console")

4. Disconnect the manual mode switch connector (A).



5. Remove the shift cable (A) from the shift lever.



6. Remove the shift lock cable from the shift lever after loosening a nut (A).

#### **Tightening torque:**

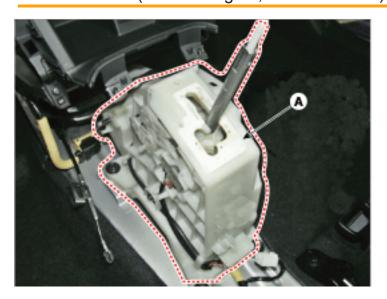
9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)



7. Remove the shift lever assembly (A) by loosening the bolts.

#### Tightening torque:

9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)

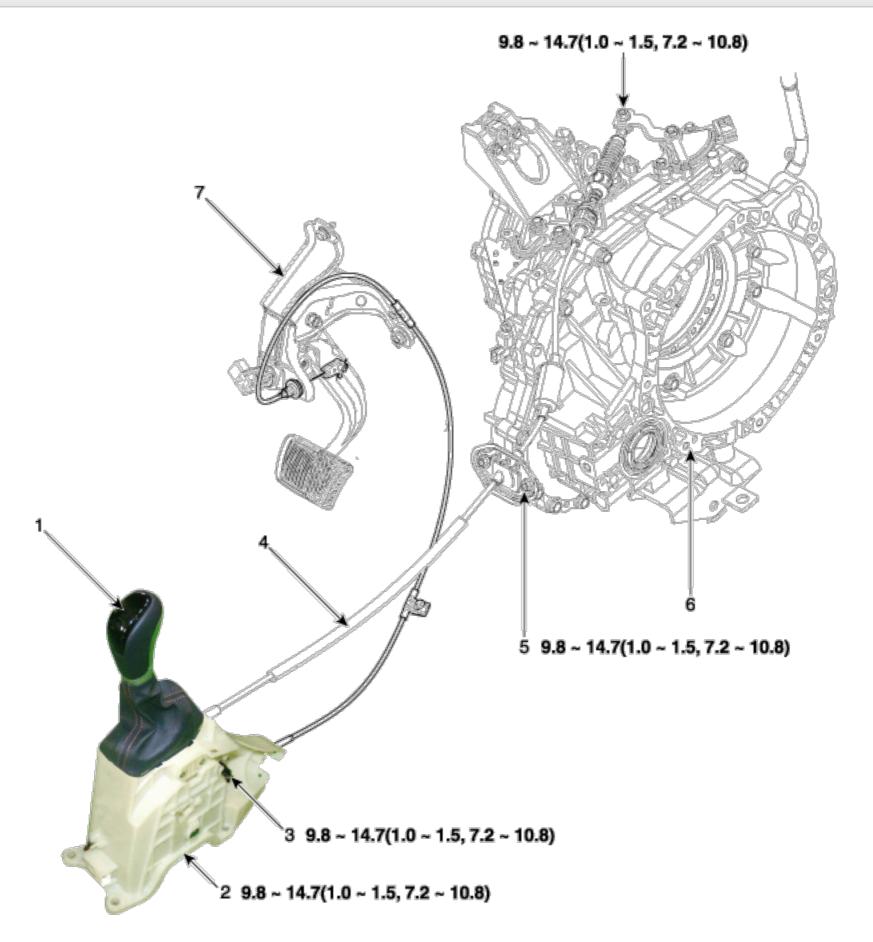


#### **INSTALLATION**

1. Install in the reverse order of removal.

## NOTICE

- When installing, set shift lever and inhibitor switch manual control lever to "N" position.
- Adjust the shift lock cable.
   (Refer to Automatic Transaxle Control System "Shift Lock Cable")



Tightening torque: N.m (kgf.m, lb-ft)

- 1. Knobe
- 2. Lever assembly
- 3. Shift lock cable
- 4. Shift cable

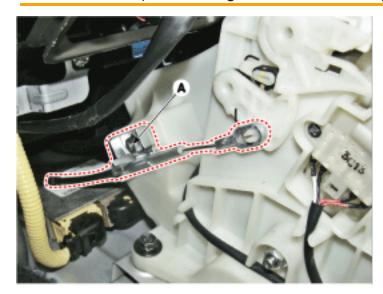
- 5. Retainer
- 6. Automatic transaxle
- 7. Brake pedal assembly

#### **REMOVAL**

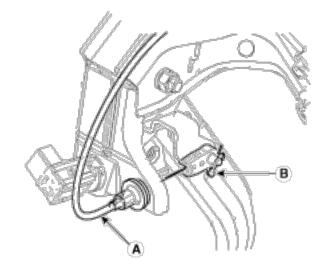
- Remove the floor console.
   (Refer to Body "Floor console")
- 2. Remove the shift lock cable from the shift lever after loosening a nut (A).

#### **Tightening torque:**

9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)



3. Remove the shift lcok cable (A) from the brake pedal assembly after removing a pin (B)



#### **INSTALLATION**

1. Install in the reverse order of removal.

### **ADJUSTMENT**

#### Adjusting method for shift lock cable

- 1. Shift lever to "N" position.
- 2. Shift lock cable must be assembled to shift lever assembly as shown in Illustration.

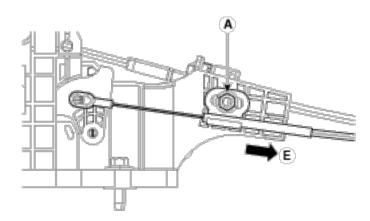
NOTICE

Cable end must be inserted into fixing pin of lock cam securely.

- 3. Maintain close adhesion lock cam and lock cam stopper slightly pull outer casing of shift lock cable in direction "E" to remove slack of shift lock cable
- 4. After checking that cable end is touched to cable fixing pin of lock cam, tighten the nut (A).

#### **Tightening torque:**

9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)



#### **INSPECTION**

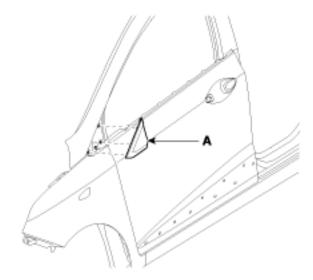
- 1. Brake pedal being not depressed, shift lever must not be shifted from "P" position to "R" position.
- 2. Brake pedal being not depressed, shift lever must not be shifted from "N" position to "R" position.
- 3. Brake pedal being depressed by stroke 12~16 mm in "P" position, push button can be operated and shift lever can be shifted smoothly from each position to other position.
- 4. Brake pedal must be operated smoothly without interruption at all position.

# **▲** CAUTION

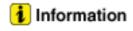
• Put on gloves to protect your hands.

## NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Take care not to scratch the body surface.
- 1. Using a screwdriver or remover, remove the Tail Gate Garnish (A).



2. Install in the reverse order of removal.

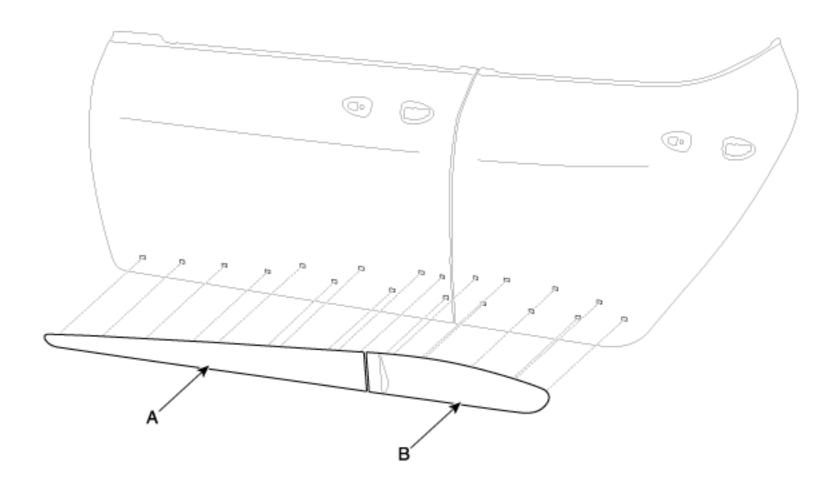


# **▲** CAUTION

• Put on gloves to protect your hands.

## NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Take care not to scratch the body surface.
- 1. Using a screwdriver or remover, remove the front door garnish (A) and rear door garnish (B).



2. Install in the reverse order of removal.

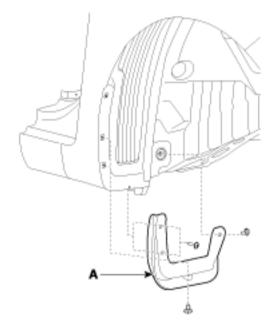


# **▲** CAUTION

• Put on gloves to protect your hands.

## NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Take care not to scratch the body surface.
- 1. After loosening the mounting clip and screws, then remove the front mud guard (A).



2. Install in the reverse order of removal.

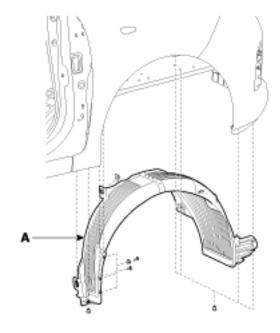


# **▲** CAUTION

• Put on gloves to protect your hands.

## NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Take care not to scratch the body surface.
- 1. Remove the front tire.
- 2. After loosening the mounting bolt, nut, clip, screw, then remove the front wheel guard (A).



3. Install in the reverse order of removal.

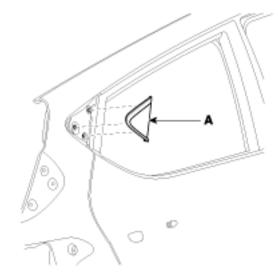


# **▲** CAUTION

• Put on gloves to protect your hands.

## NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Take care not to scratch the body surface.
- 1. Using a screwdriver or remover, remove the quarter garnish (A).



2. Install in the reverse order of removal.

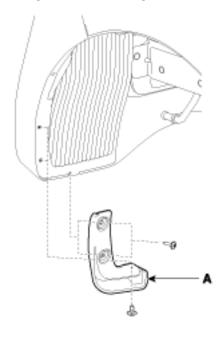


# **▲** CAUTION

• Put on gloves to protect your hands.

## NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Take care not to scratch the body surface.
- 1. After loosening the mounting clip and screws, then remove the rear mud guard (A).



2. Install in the reverse order of removal.

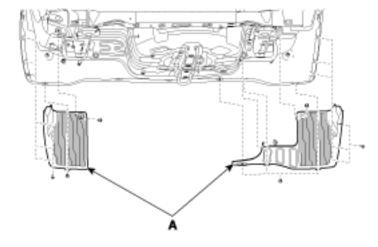


# **▲** CAUTION

• Put on gloves to protect your hands.

## NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Take care not to scratch the body surface.
- 1. Remove the rear tire.
- 2. After loosening the mounting clips and screws, then remove the rear wheel guard (A).



3. Install in the reverse order of removal.





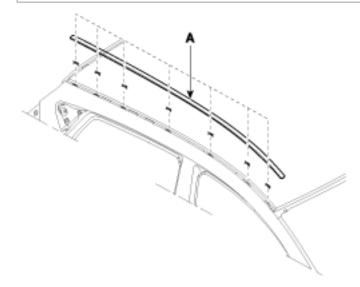
• Put on gloves to protect your hands.

## NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Take care not to scratch the body surface.
- 1. Using a screwdriver or remover, remove the roof side molding (A).

# i Information

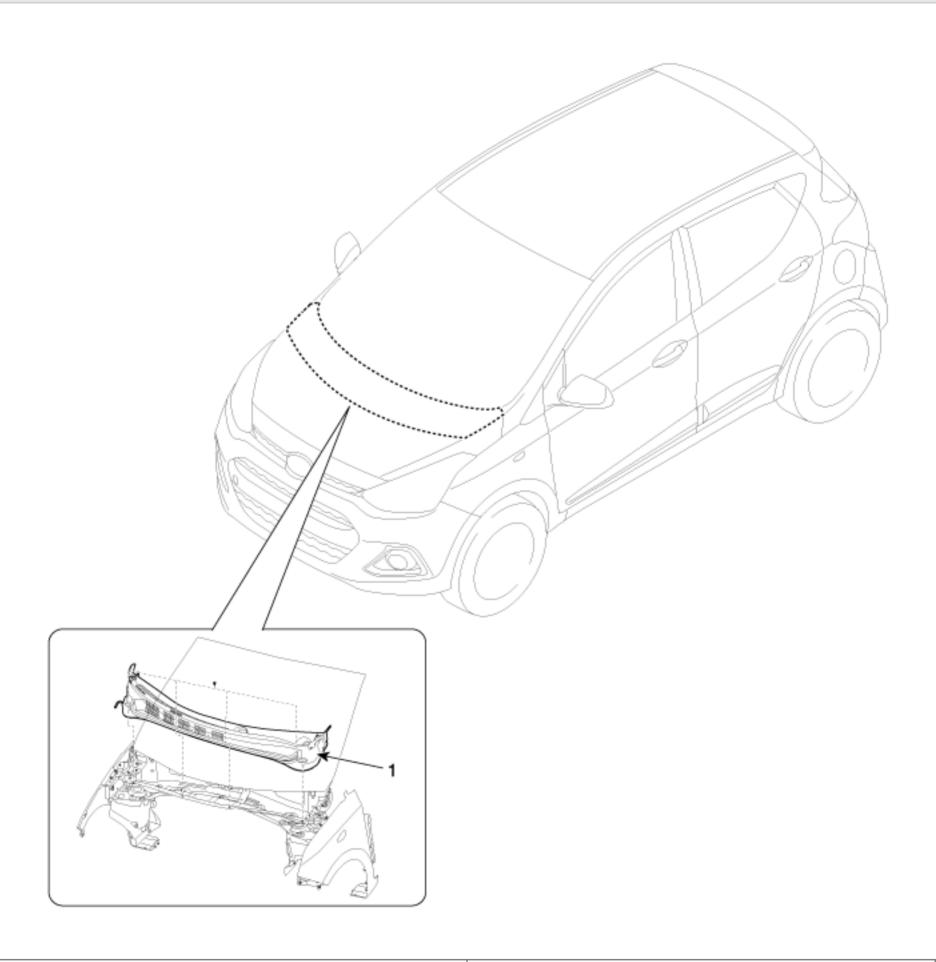
Replace the roof side molding to a new one.



2. Install in the reverse order of removal.



# **COMPONENT LOCATION**

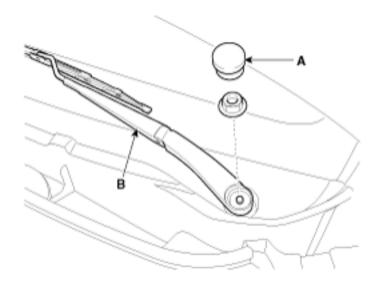


1. Cowl top cover

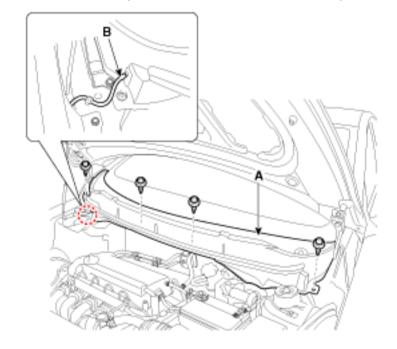
1. Remove the cap (A) and remove the nuts, then remove the wiper arm (B).

### Tightening torque:

22.6 ~ 26.5 N.m (2.3 ~ 2.7 kgf.m, 16.6 ~ 19.5 lb-ft)



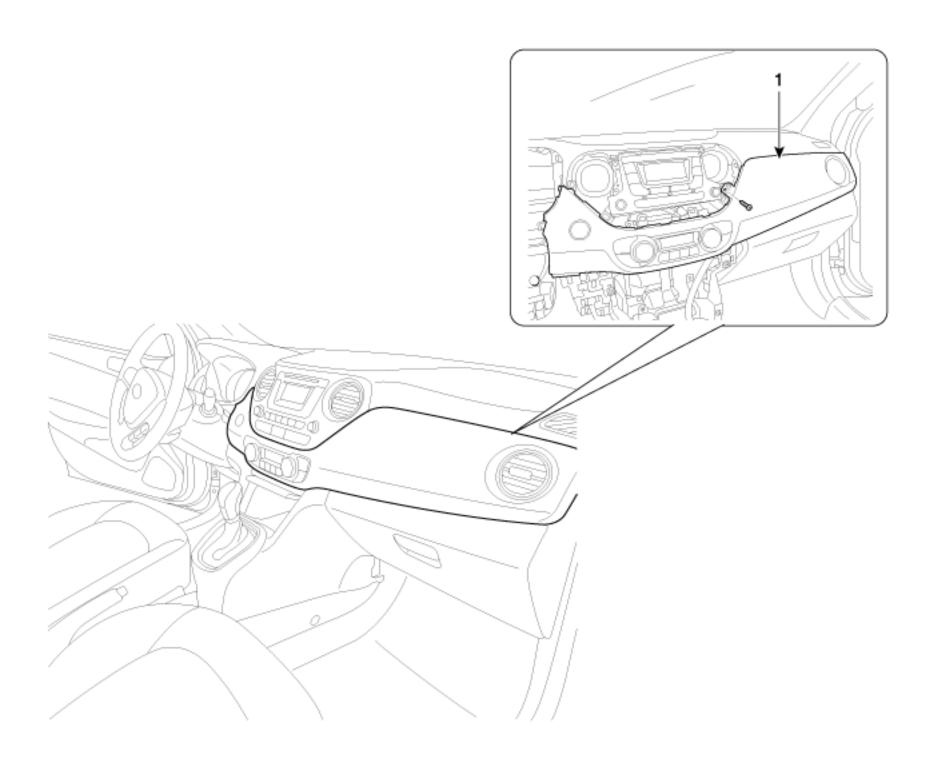
- 2. Disconnect the cowl top cover nozzle hose (B).
- 3. Detach the clips, then remove the cowl top cover (A).



4. Install in the reverse order of removal.

## 1 Information

# **COMPONENT LOCATION**



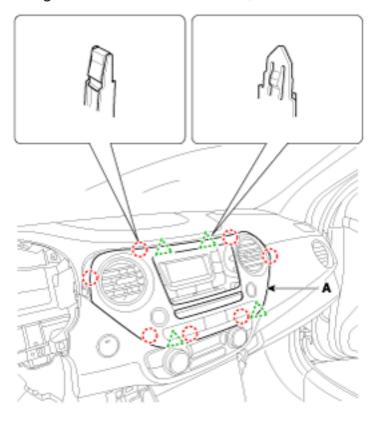
1. Center fascia panel

## **▲** CAUTION

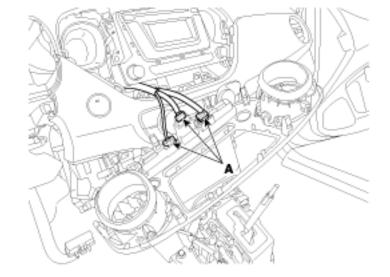
• Put on gloves to protect your hands.

## NOTICE

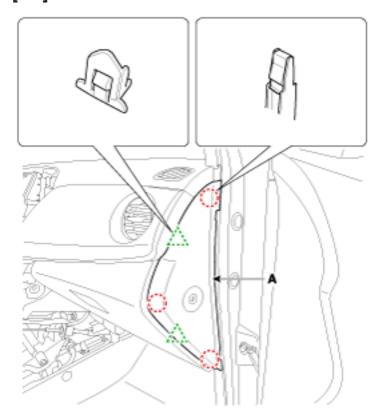
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. Using a screwdriver or remover, remove the crash pad center garnish (A).
- Remove the cluster fascia panel.
   (Refer to Interior Trim "Cluster Fascia Panel")
- Remove the floor console assembly.
   (Refer to Floor Console "Floor Console Assembly ")
- 4. Using a screwdriver or remover, remove the center fascia panel (A).



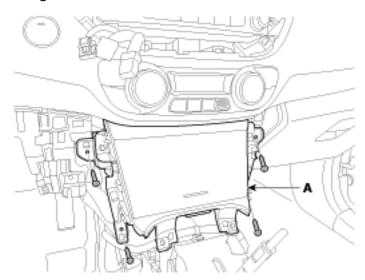
5. Disconnect the hazard switch connector (A).



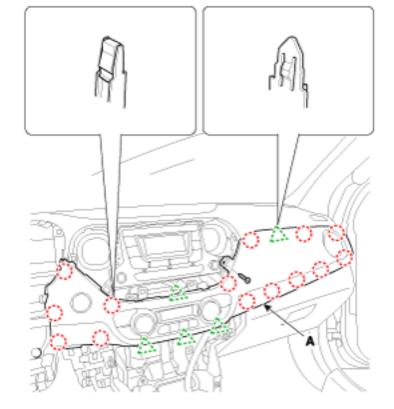
6. Using a screwdriver or remover, remove the crash pad side cover (A). **[RH]** 



7. Using a screwdriver or remover, remove the consol tray garnish (A).



8. After loosening the mounting screws, then remove the crash pad center garnish assembly (A).

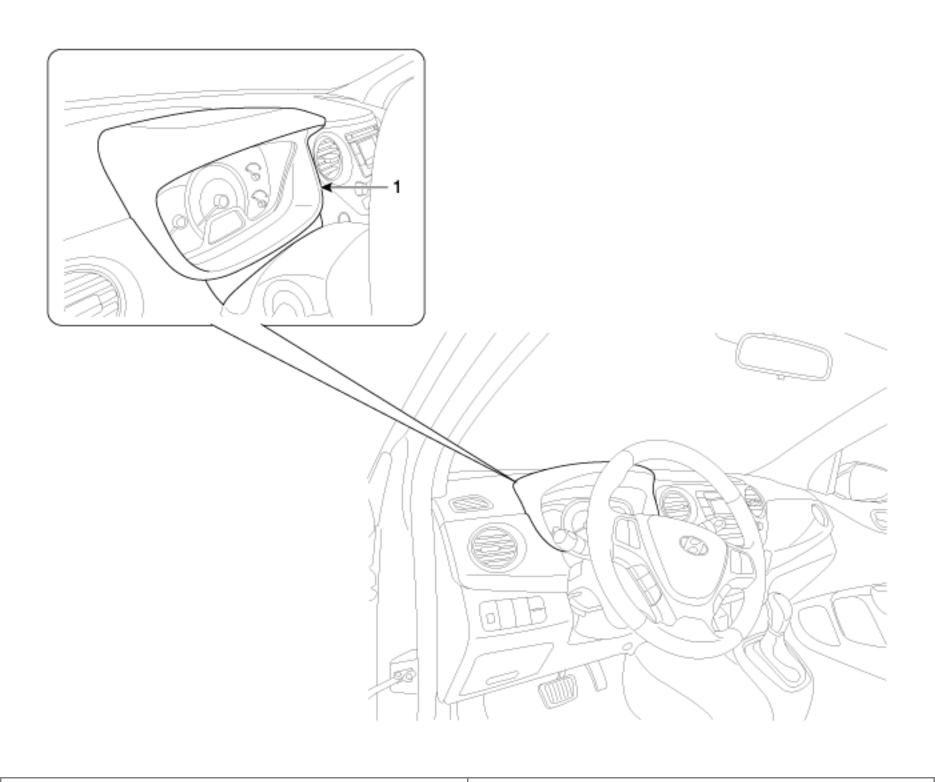


9. Install in the reverse order of removal.

# 1 Information

- Make sure the connector are connected in properly.
- Replace any damaged clips.

# **COMPONENT LOCATION**



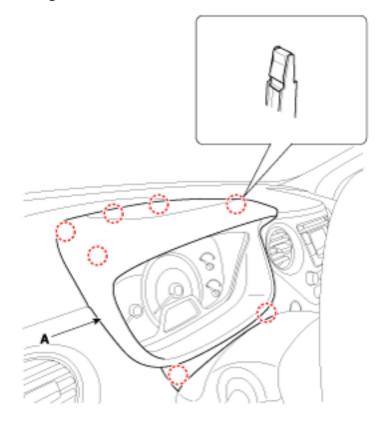
1. Cluster fascia panel

## **▲** CAUTION

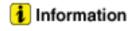
• Put on gloves to protect your hands.

## NOTICE

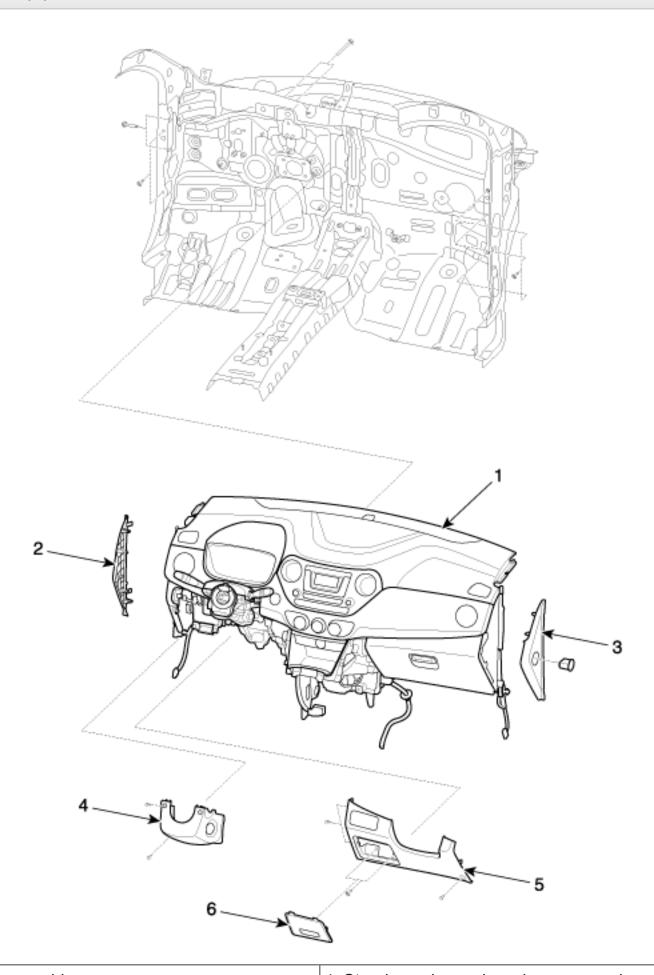
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. Using a screwdriver or remover, remove the cluster fascia panel (A).



2. Install in the reverse order of removal.

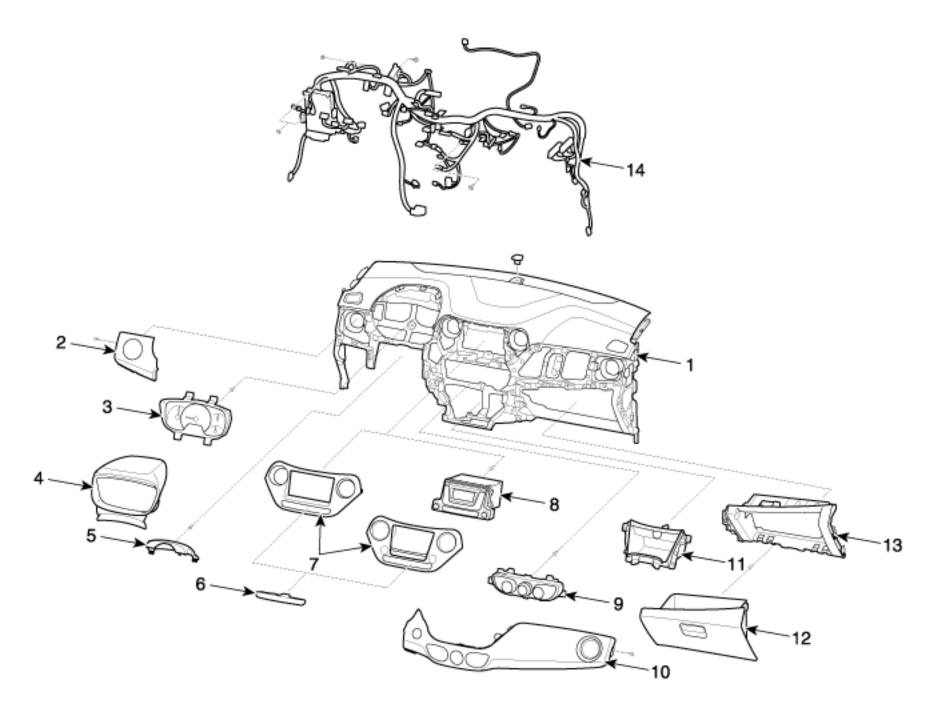


## **COMPONENTS (1)**



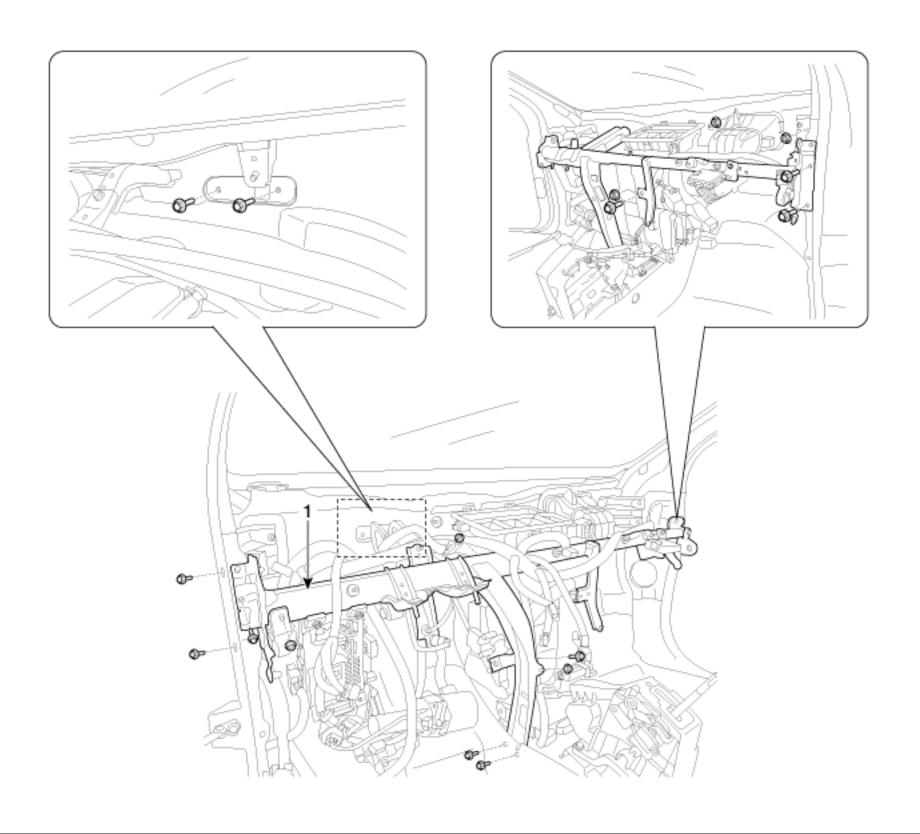
- 1. Main crash pad assembly
- 2. Crash pad side cover [LH]
- 3. Crash pad side cover [RH]

- 4. Steering column shroud upper panel
- 5. Crash pad lower panel
- 6. Fuse box cover



- 1. Crash pad main assembly
- 2. Crash pad garnish [LH]
- 3. Cluster assembly
- 4. Cluster fascia panel
- 5. Steering column shroud upper panel
- 6. Center switch assembly
- 7. Center fascia panel
- 8. Audio assembly
- 9. Heater control
- 10. Crash pad center garnish assembly
- 11. Crash pad center lower tray assembly
- 12. Glove box housing
- 13. Glove box lower cover
- 14. Crash pad main wiring harness

# **COMPONENT LOCATION**



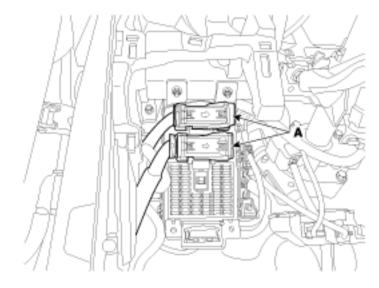
1. Cowl cross bar assembly

# **▲** CAUTION

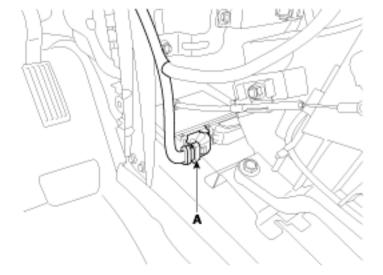
Put on gloves to protect your hands.

### **NOTICE**

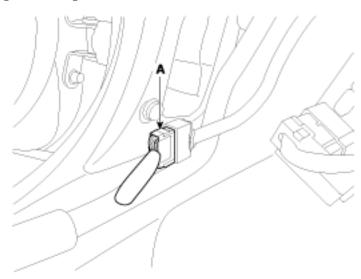
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the cowl top cover. (Refer to "Cowl Top Cover")
- Remove the main crash pad assembly. (Refer to Crash Pad - "Main Crash Pad Assembly")
- Disconnect the steering column connectors.
   (Refer to Steering System "Steering Column and Shaft")
- 4. Down the steering column after loosening the mounting bolts. (Refer to Steering System "Steering Column and Shaft")
- 5. Disconnect the blower unit connectors.
- 6. Disconnect the passenger compartment junction box connectors (A).



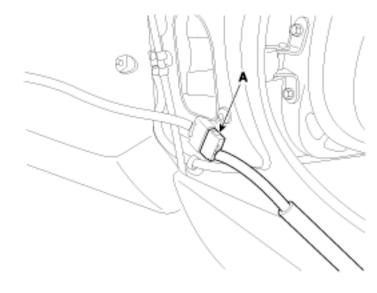
7. Disconnect the airbag control module (SRSCM) connector (A).



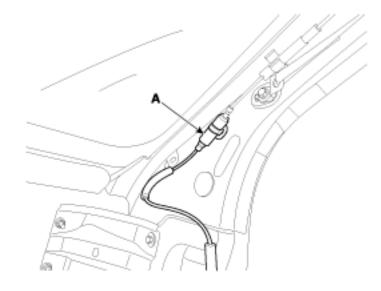
8. Disconnect the multi box connectors (A). [Driver's]



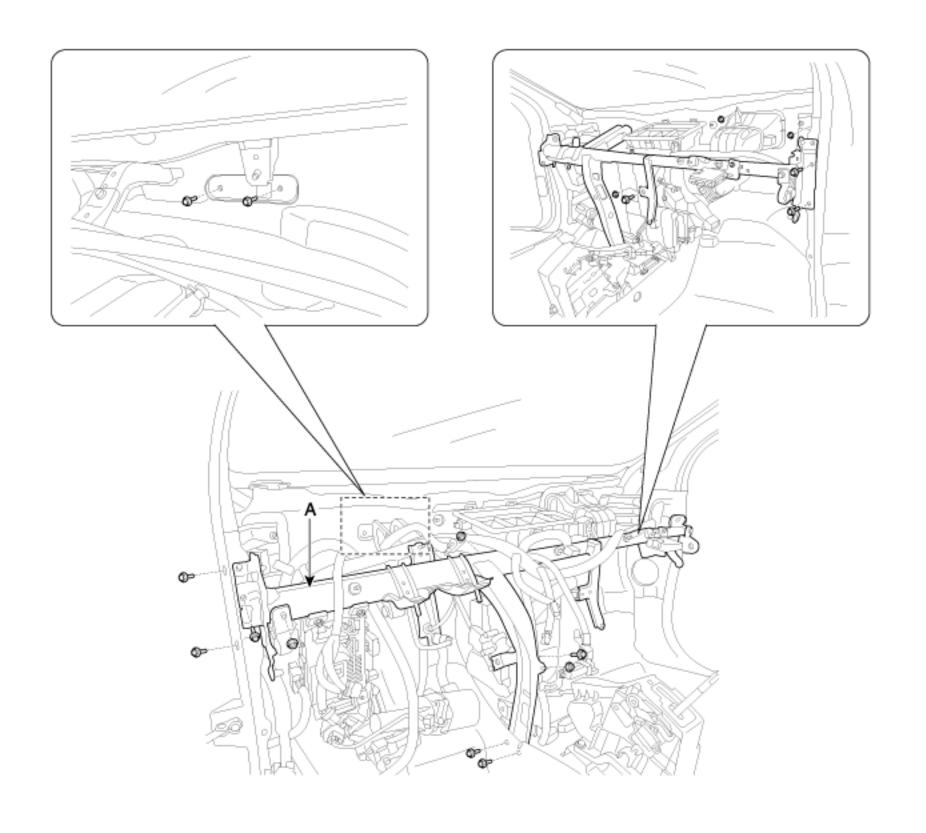
[Passenger's]



9. Disconnect the connectors (A) and the mounting clips in the front pillar. **[Passenger's]** 



10. After loosening the mounting bolts and nuts, then remove the cowl cross bar assembly (A).

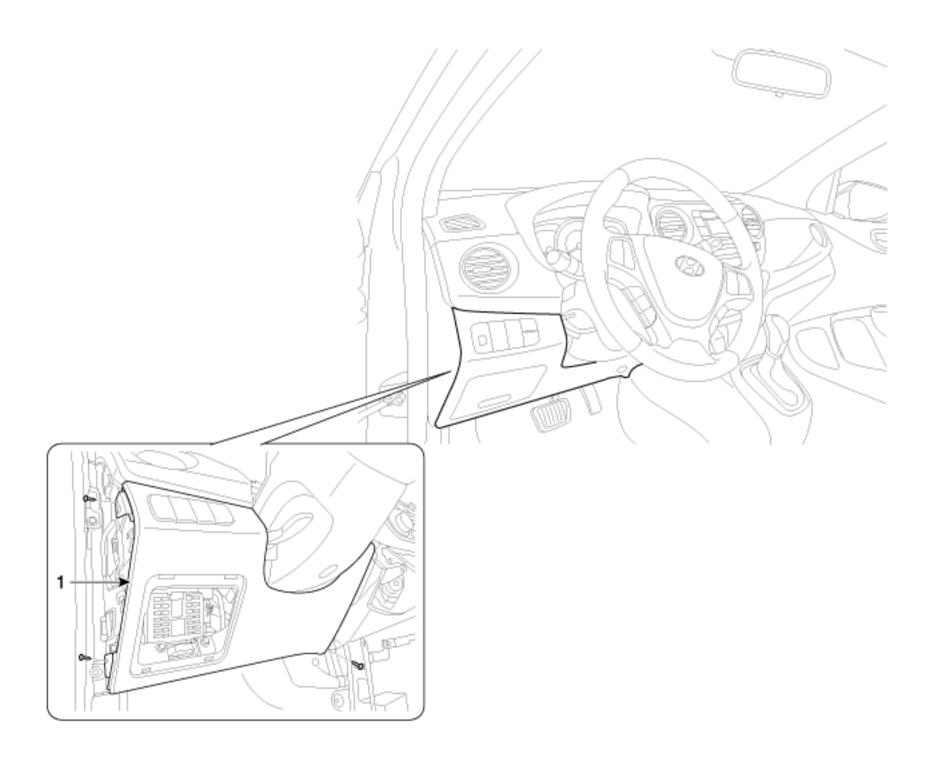


11. Install in the reverse order of removal.

# i Information

- Make sure the crash pad fits onto the guide pins correctly.
- Before tightening the bolts, make sure the crash pad wire harnesses are not pinched.
- Make sure the connectors are plugged in properly, and the antenna lead is connected properly.
- Enter the anti- theft code for the radio, then enter the customer`s radio station presets.

# **COMPONENT LOCATION**



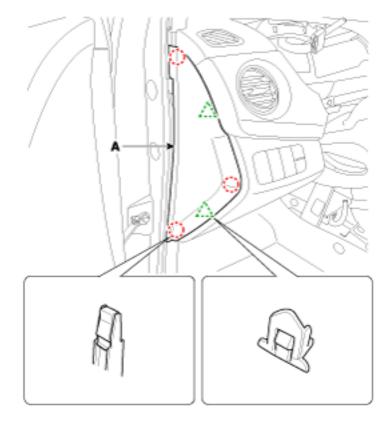
1. Crash pad lower panel

# **▲** CAUTION

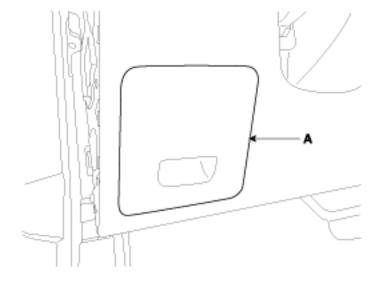
• Put on gloves to protect your hands.

## NOTICE

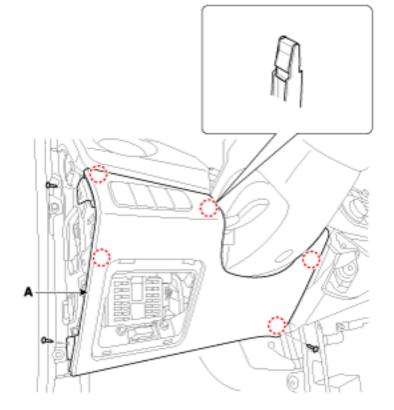
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. Using a screwdriver or remover, remove the crash pad side cover [LH] (A).



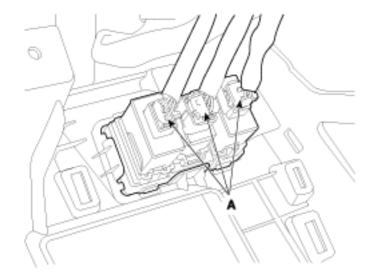
2. Using a screwdriver or remover, remove the fuse box cover (A).



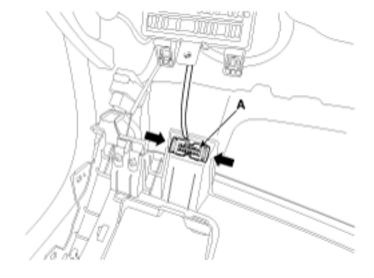
3. After loosening the mounting bolt and screws, then remove the crash pad lower panel (A).



4. Disconect the connector (A).



5. Disconnect the diagnoisis connector (A).



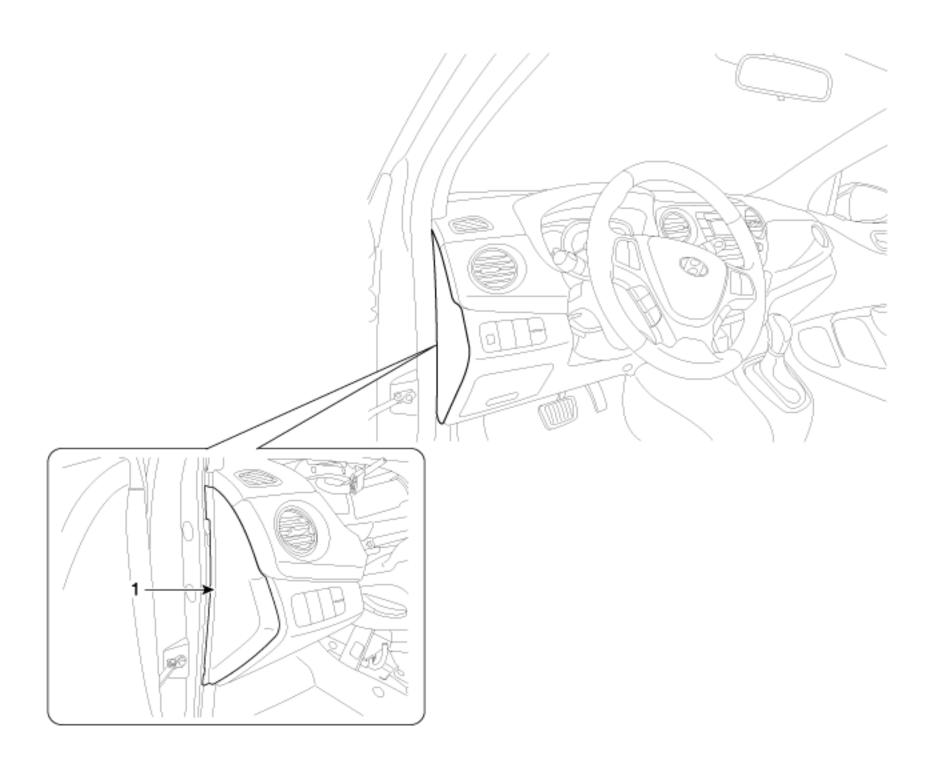
6. Install in the reverse order of removal.

# information

- Make sure the connector are connected in properly.
- Replace any damaged clips.

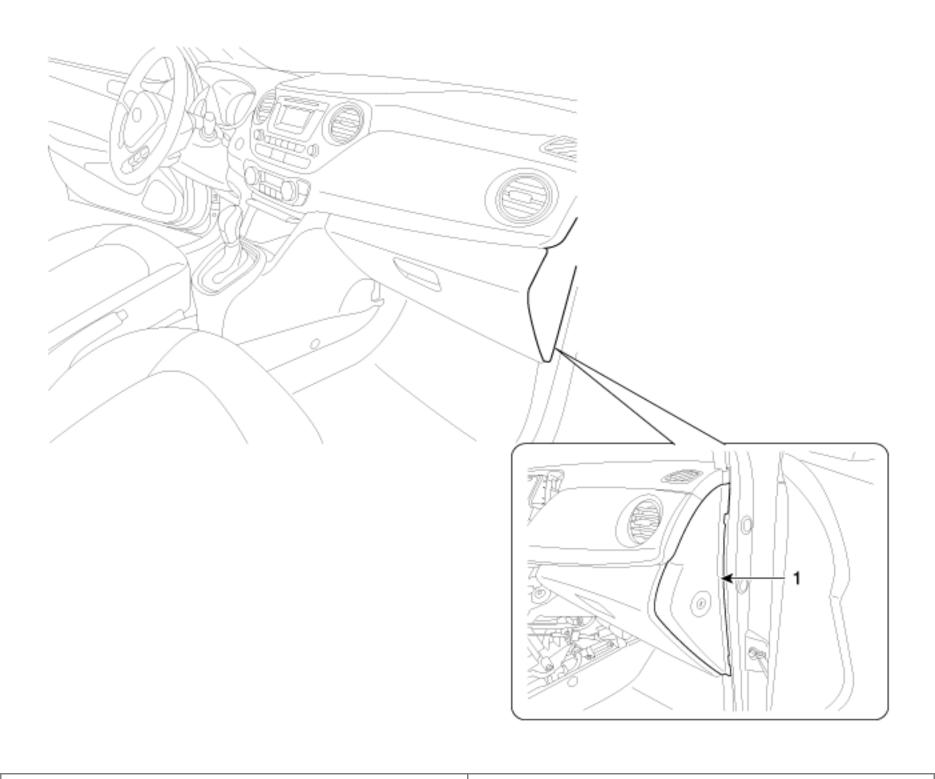
# **COMPONENT LOCATION**

[LH]



1. Crash pad side cover [LH]

[RH]



1. Crash pad side cover [RH]

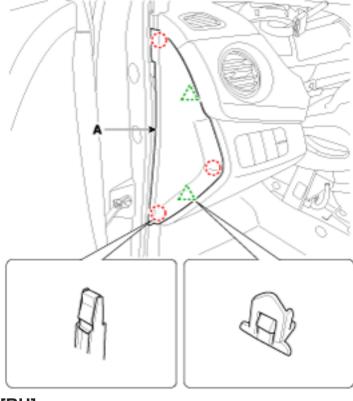
## **▲** CAUTION

• Put on gloves to protect your hands.

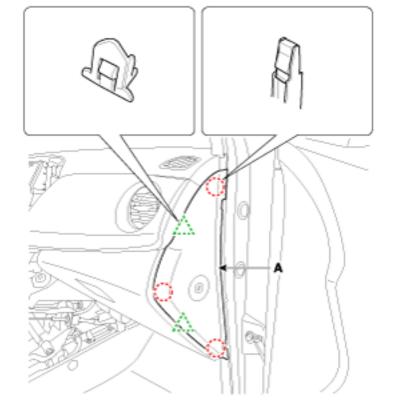
## NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. Using a screwdriver or remover, remove the crash pad side cover (A).

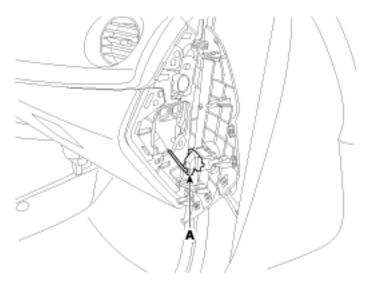
### [LH]



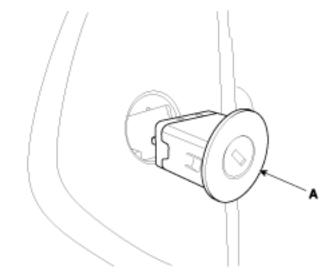
[RH]



2. Disconnect the PAB ON/OFF switch connector (A).



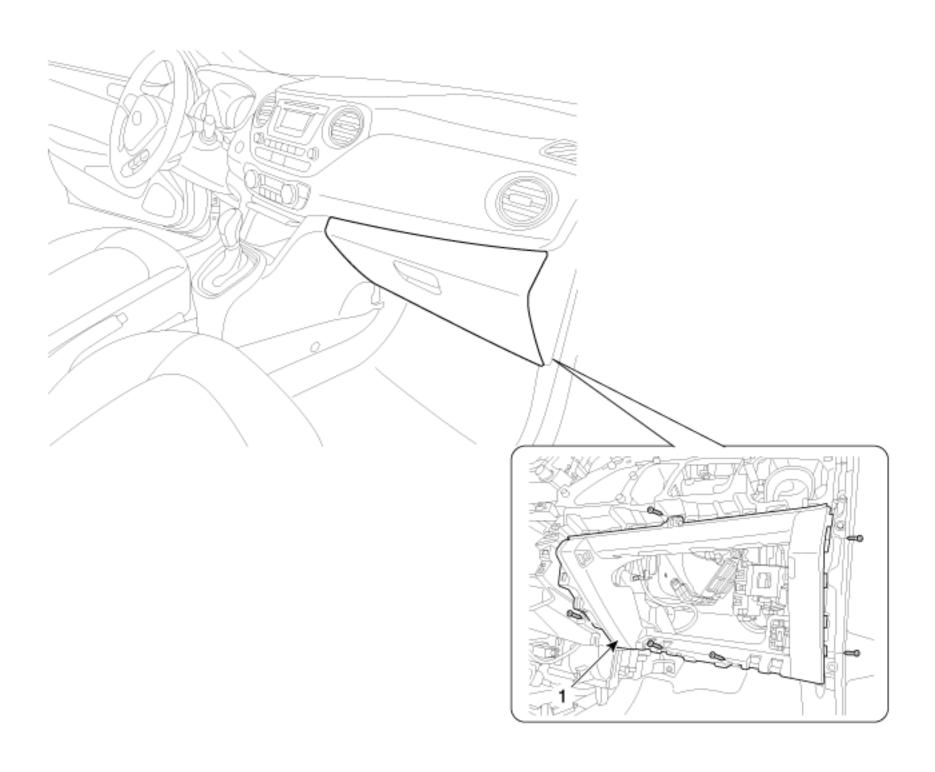
3. Remove the PAB ON/OFF switch (A).



4. Install in the reverse order of removal.



• Replace any damaged clips.



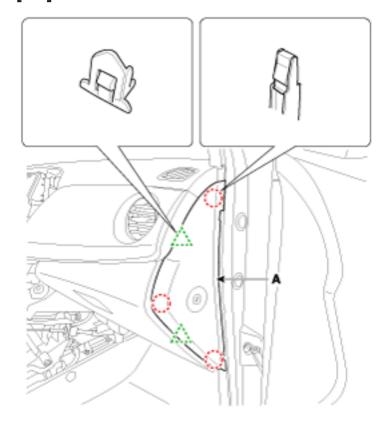
1. Glove box housing

### **▲** CAUTION

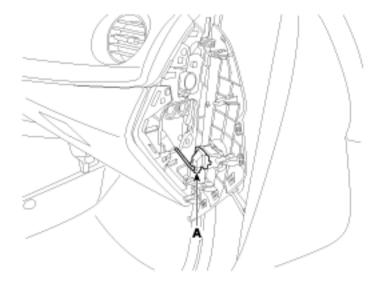
• Put on gloves to protect your hands.

### NOTICE

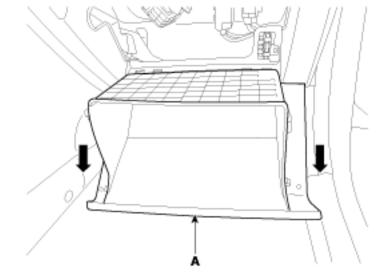
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Using a screwdriver or remover, remove the crash pad side cover [RH] (A).
   [RH]



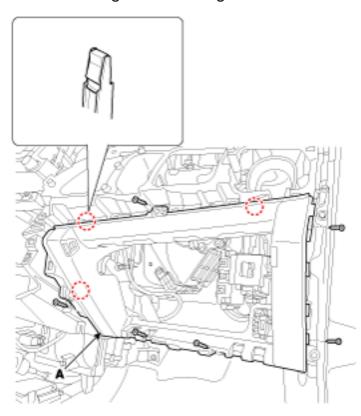
2. Disconnect the PAB ON/OFF switch connector (A).



3. Remove the glove box (A).



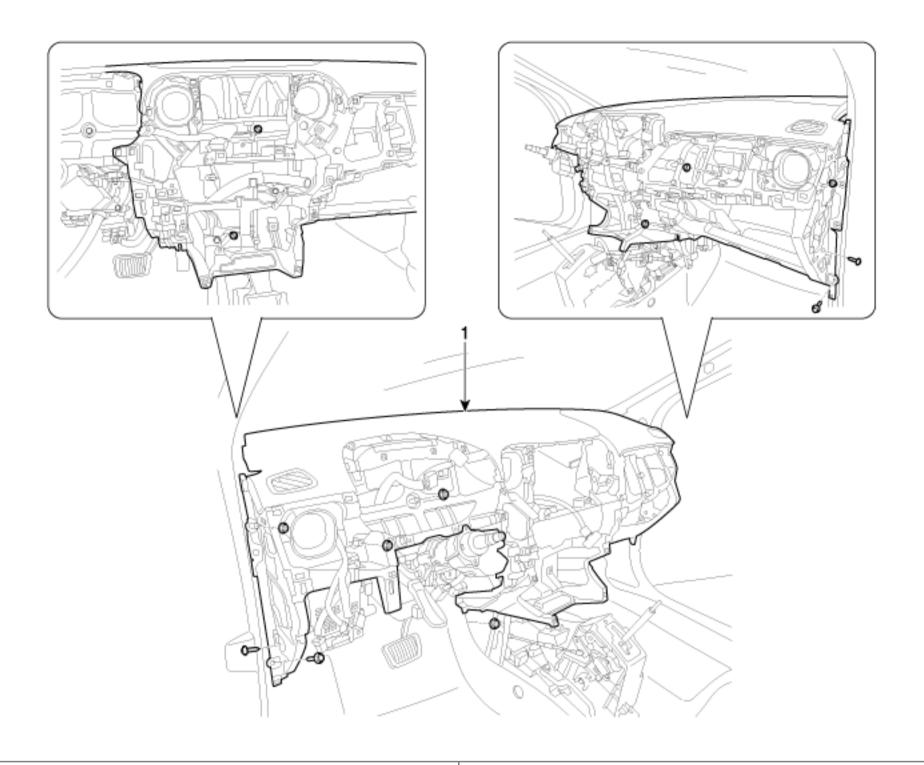
4. After loosening the mounting screws and bolts, then remove the glove box housing (A).



5. Install in the reverse order of removal.

# 1 Information

- Make sure the connector are connected in properly.
- Replace any damaged clips.



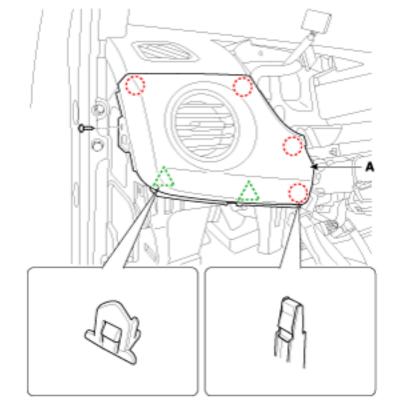
1. Main crash pad assembly

#### **▲** CAUTION

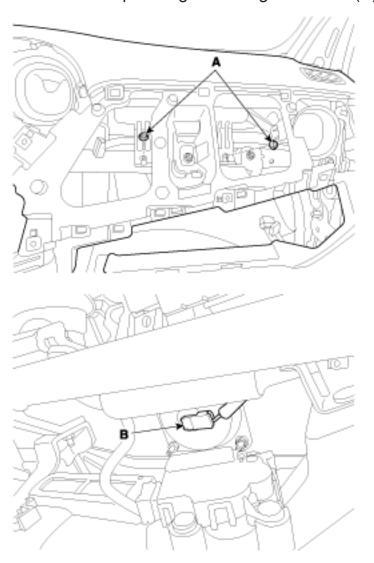
Put on gloves to protect your hands.

#### NOTICE

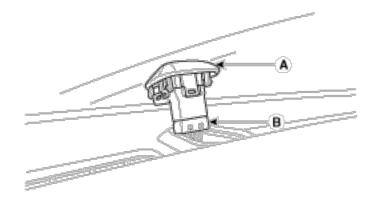
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the front pillar trim.
   (Refer to Interior Trim "Front Pillar Trim")
- Remove the cowl side trim. (Refer to Interior Trim - "Cowl Side Trim")
- Remove the instrument cluster.
   (Refer to Body Electrical System "Instrument Cluster")
- Remove the crash pad lower panel.
   (Refer to Crash Pad "Crash Pad Lower Panel")
- Remove the audio unit. (Refer to Body Electrical System - "Audio Unit")
- Remove the heater control.
   (Refer to Heating, Ventilation, Air Conditioning "Heater & A/C Control Unit")
- Remove the glove box housing.
   (Refer to Crash Pad "Glove Box Housing")
- Remove the steering column shroud lower panel. (Refer to Crash Pad - "Steering Column Shroud Panel")
- Remove the steering wheel.
   (Refer to Steering System "Steering Wheel")
- Remove the multifunction switch assembly.
   (Refer to Body Electrical System "Multifunction Switch")
- 11. After loosening the mounting screws, then remove the crash pad garnish [LH] (A).



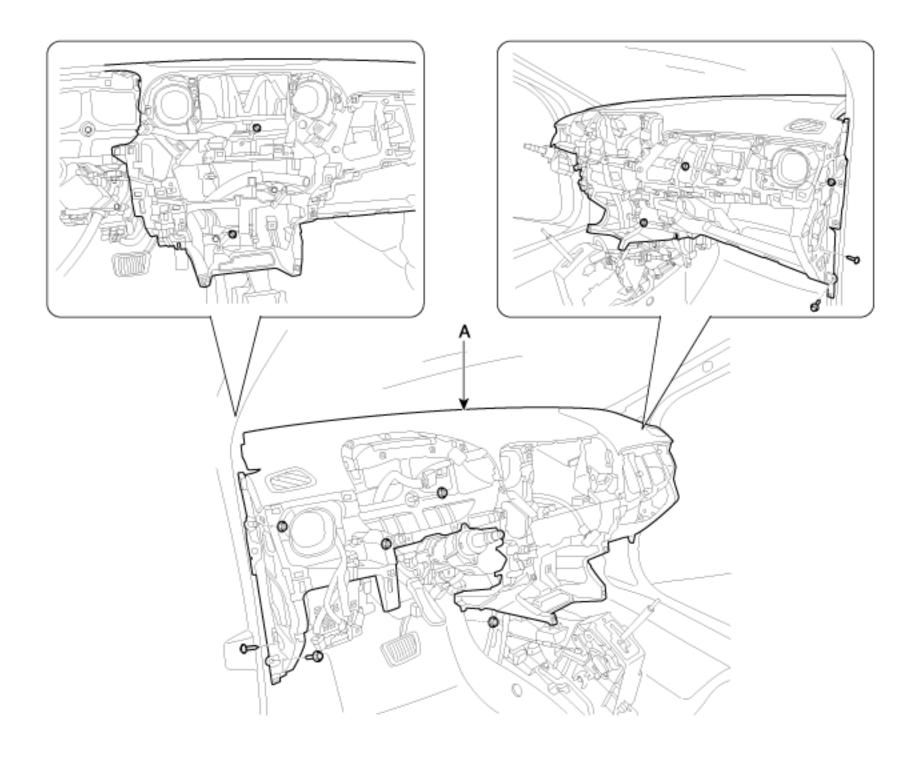
- 12. Loosen the mounting nuts (A).
- 13. Disconnect the passenger's airbag connector (B).



- 14. Using a screwdriver or remover, remove the photo sensor (A).
- 15. Disconnect the photo sensor connector (B).



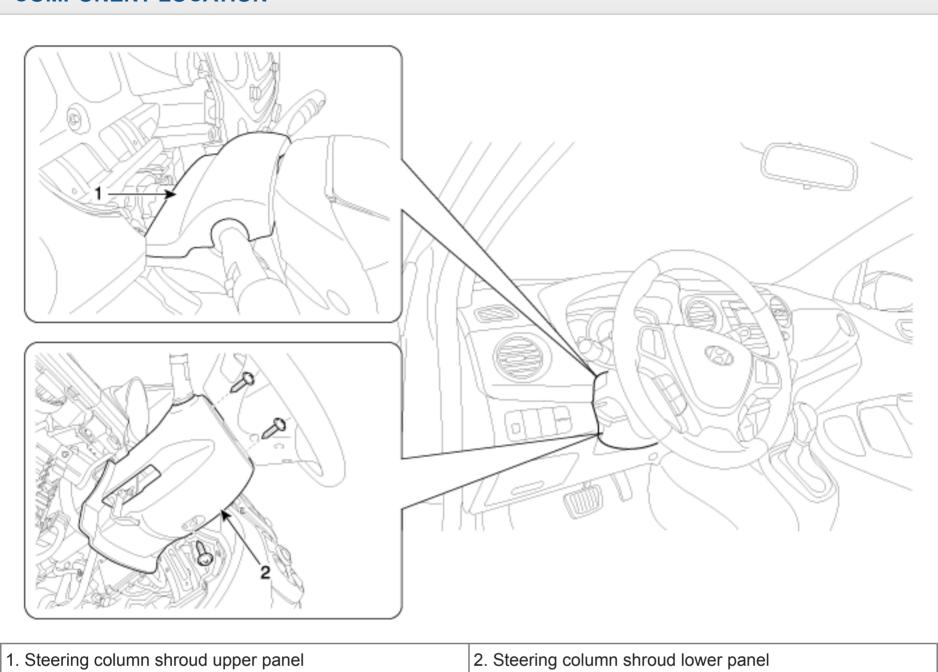
16. After loosening the mounting bolts, nuts, then remove the main crash pad assembly (A).



17. Install in the reverse order of removal.

# i Information

- Make sure the crash pad fits onto the guide pins correctly.
- Before tightening the bolts, make sure the crash pad wire harnesses are not pinched.
- Make sure the connectors are plugged in properly, and the antenna lead is connected properly.
- Enter the anti- theft code for the radio, then enter the customer's radio station presets.



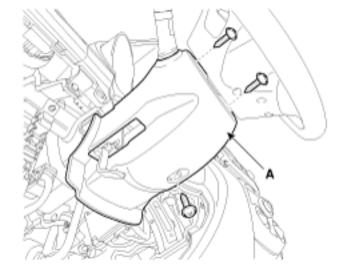
#### [Steering column shroud lower panel]

### **▲** CAUTION

Put on gloves to protect your hands.

#### NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the crash pad lower panel.
   (Refer to Crash Pad "Crash Pad Lower Panel")
- 2. After loosening the mounting screws, then remove the steering column shroud lower panel (A).



3. Install in the reverse order of removal.



Replace any damaged clips.

#### [Steering column shroud upper panel]

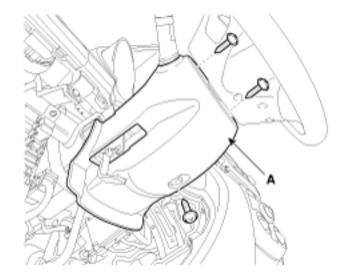
## **▲** CAUTION

• Put on gloves to protect your hands.

### NOTICE

• When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the

- related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the cluster fascia panel.
   (Refer to Crash Pad "Cluster Fascia Panel")
- 2. After loosening the mounting screws, then remove the steering column shroud lower panel (A).



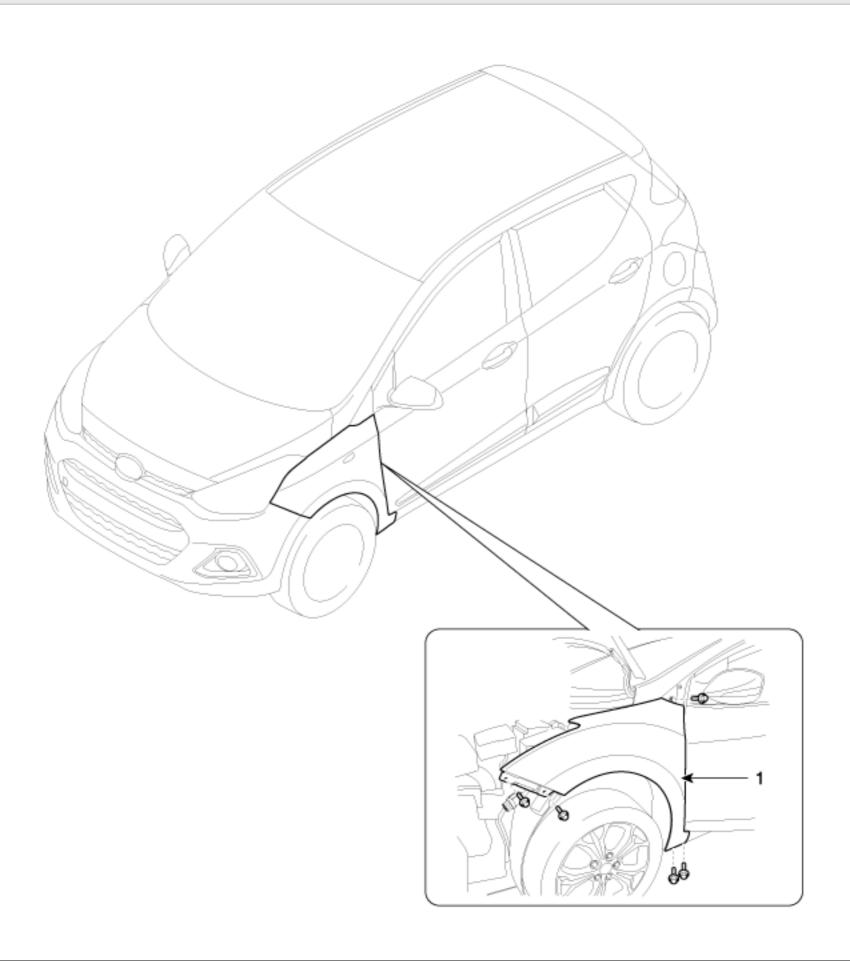
3. Remove the steering column shroud upper panel (A).



4. Install in the reverse order of removal.



• Replace any damaged clips.



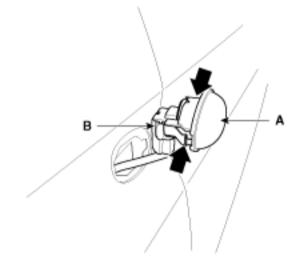
1. Fender assembly

### NOTICE

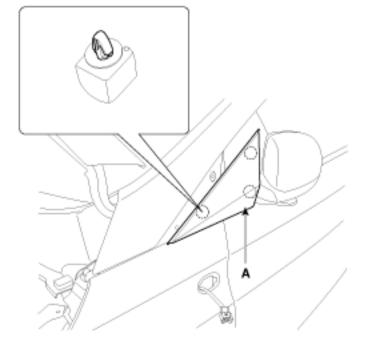
• Be careful not to damage the fender and body.

### 1 Information

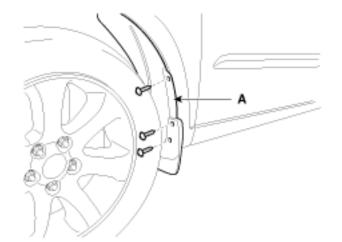
- · When removing the clips, use a clip remover.
- Remove the front bumper cover.
   (Refer to Front Bumper "Front Bumper Cover")
- Remove the head lamps.
   (Refer to Body Electrical System "Head Lamps")
- 3. Remove the side repeater lamp (A).
- 4. Disconnect the side repeater lamp connector (B).



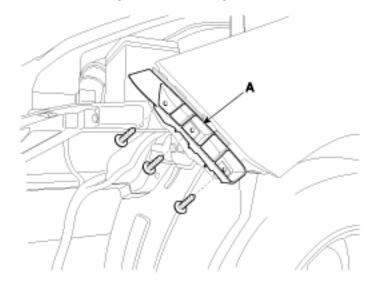
5. Using a screwdriver or remover, remove the delta garnish (A).



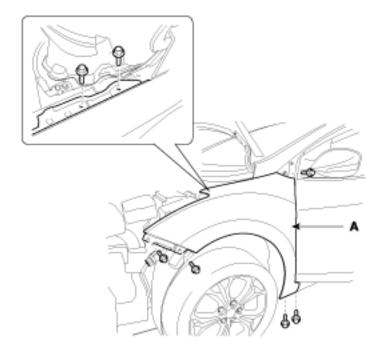
6. Loosen the wheel guard (A) mounting screws.



7. After loosening the mounting screws and bolt, then remove the front bumper side mounting bracket (A).



8. After loosening the mounting bolts and nut, then remove the fender assembly (A).



9. Install in the reverse order of removal.

## i Information

- Make sure the connector is plugged in properly.
- Replace any damaged clips.

### **▲** CAUTION

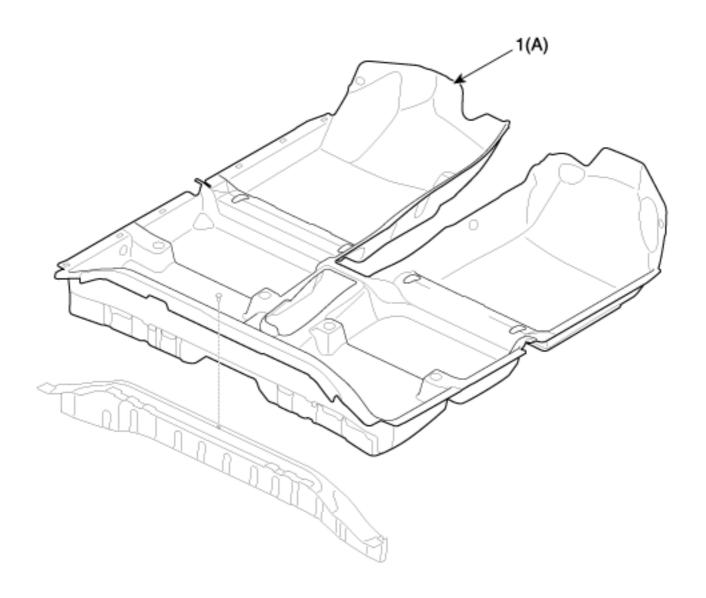
• Put on gloves to protect your hands.

#### NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the front seat assembly.
   (Refer to Front Seat "Front Seat Assembly")
- Floor console assembly. (Refer to Floor Console - "Floor Console Assembly")
- Remove the cowl side trim.(Refer to Interior Trim "Cowl Side Trim")
- Remove the center pillar lower trim.
   (Refer to Interior Trim "Center Pillar Trim")
- Remove the rear seat cushion assembly. (Refer to Rear Seat - "Rear Seat Assembly")
- 6. Remove the floor carpet assembly (A).
- 7. Install in the reverse order of removal.

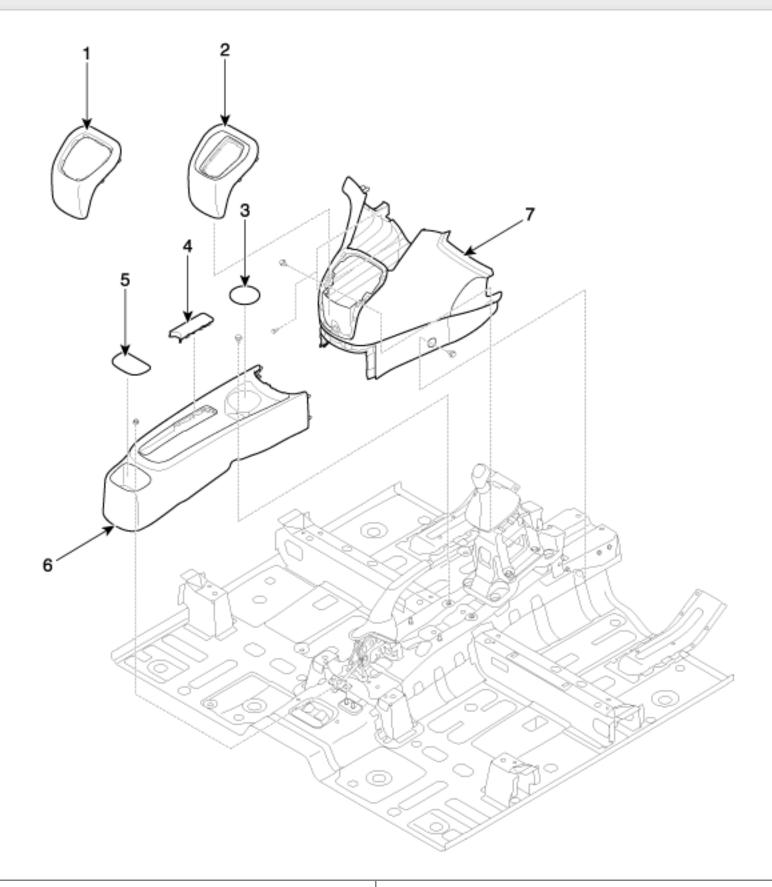
### i Information

Replace any damaged clips.



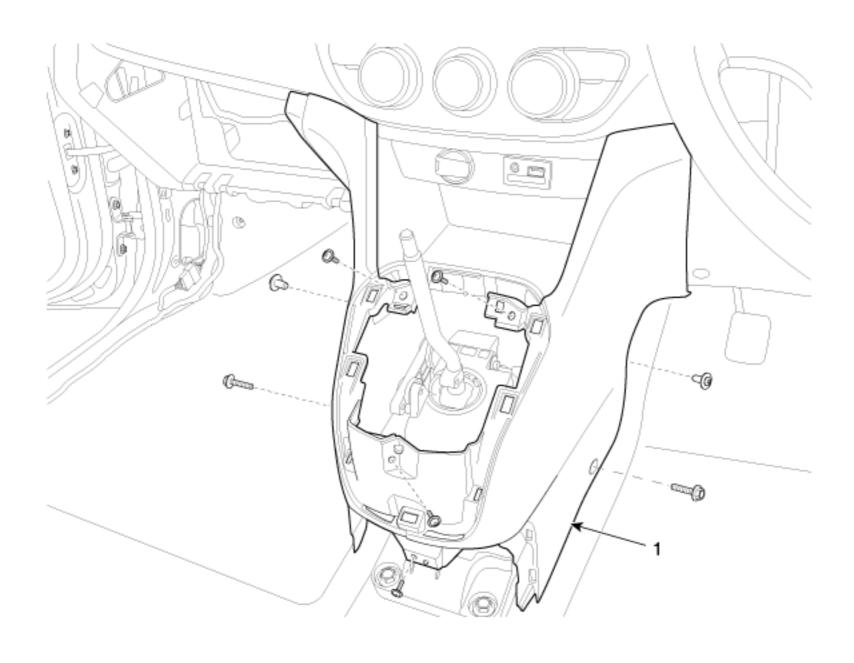
1. Floor carpet assembly

## **COMPONENTS**



- 1. Console upper cover [MT]
- 2. Console upper cover [AT]
- 3. Cup holder mat
- 4. Parking brake cover

- 5. Console tray mat
- 6. Floor console assembly
- 7. Front console assembly



1. Front console assembly

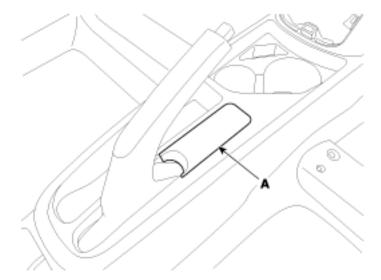
#### [M/T]

# **▲** CAUTION

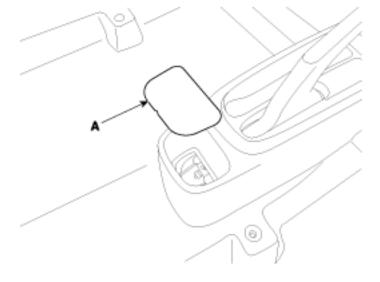
Put on gloves to protect your hands.

### NOTICE

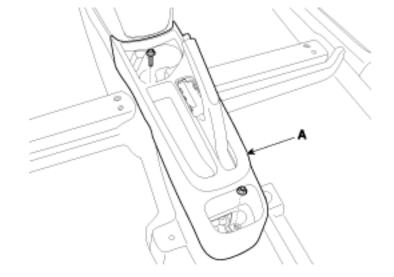
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. Using a screwdriver or remover, remove the parking brake cover (A).



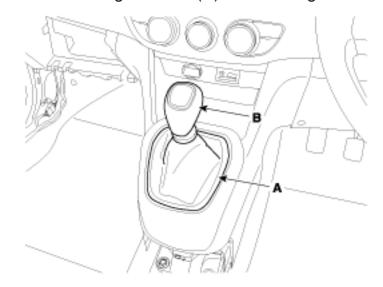
2. Remove the console tray mat (A).



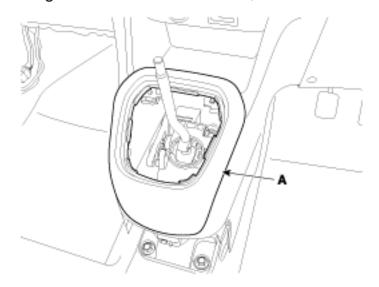
3. After loosening the mounting nut and bolt, then remove the floor console assembly (A).



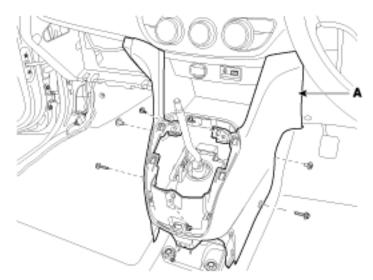
- 4. Using a screwdriver or remover, remove the gear boots (A).
- 5. Remove the gear knob (B) after turning in the counter clock-wise direction.



6. Using a screwdriver or remover, remove the console upper cover (A).



7. After loosening the mounting bolts and screws, clips, then remove the front console assembly (A).



8. Install in the reverse order of removal.

# i Information

- · Make sure the connector is connected properly.
- Replace any damaged clips.

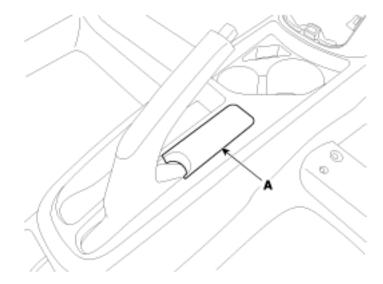
#### [A/T]



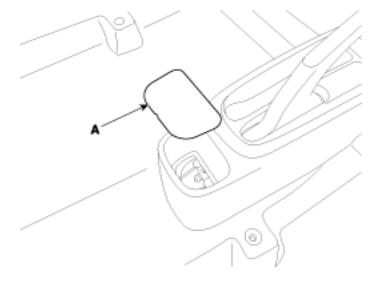
Put on gloves to protect your hands.

### NOTICE

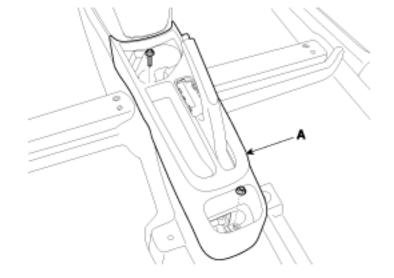
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. Using a screwdriver or remover, remove the parking brake cover (A).



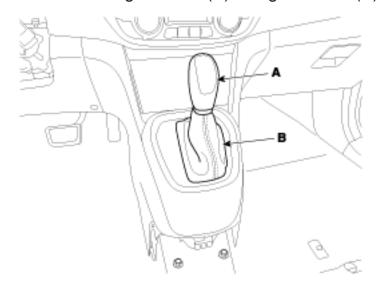
2. Remove the console tray mat (A).



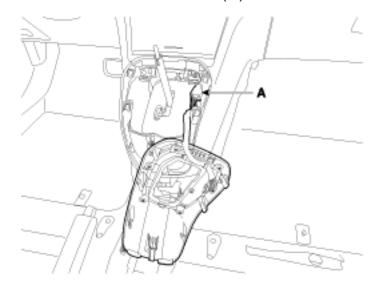
3. After loosening the mounting nut and bolt, then remove the floor console assembly (A).



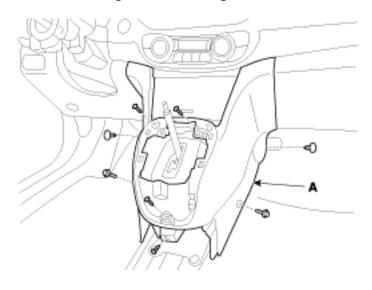
4. To remove the gear knob (A) and gear boots (B) pull both of it up.



5. Disconnect the connectors (A).



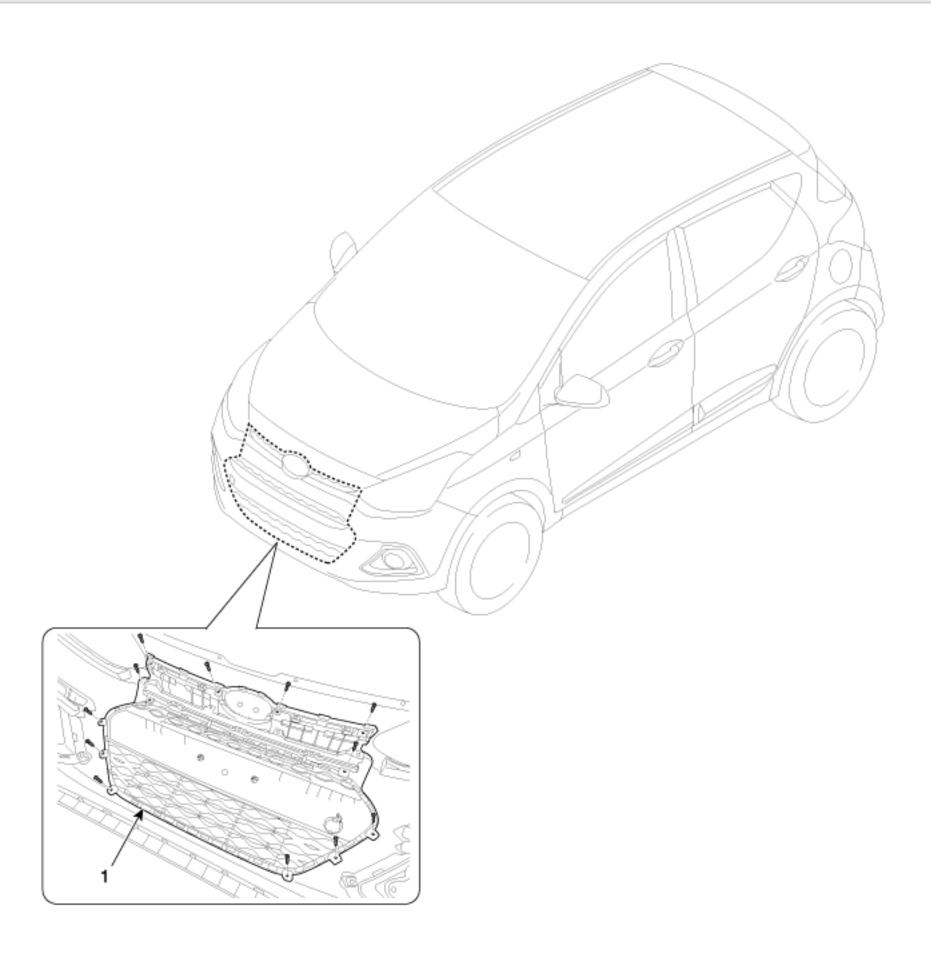
6. After loosening the mounting bolts and screws, clips, then remove the front console assembly (A).



7. Install in the reverse order of removal.

# i Information

- Make sure the connector is connected properly.
- Replace any damaged clips.



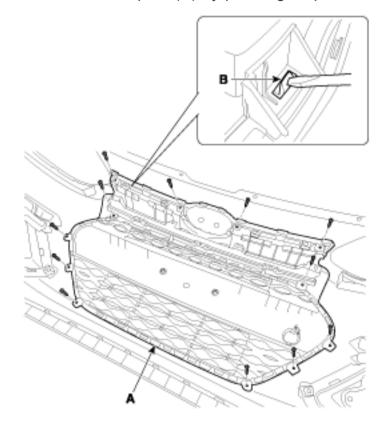
1. Bumper grille

## **▲** CAUTION

• Put on gloves to protect your hands.

### NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the front bumper cover.
   (Refer to Front Bumper "Front Bumper Cover")
- 2. Loosen the radiator grill mounting screws.
- 3. Unlock the lock pins (B) by pushing it up with a screwdriver or remover and then remove the bumper grille (A).

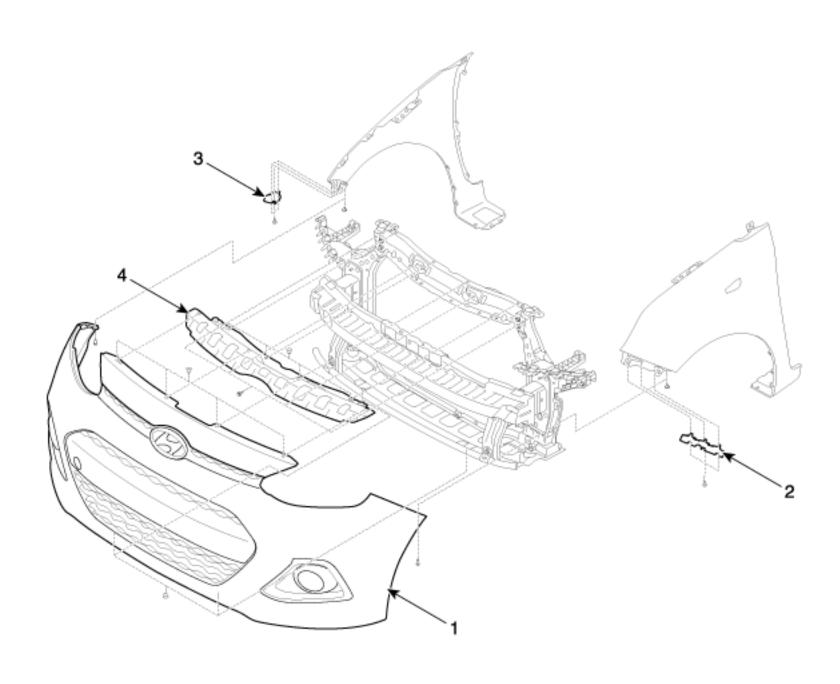


4. Install in the reverse order of removal.

# i Information

Replace any damaged clips.

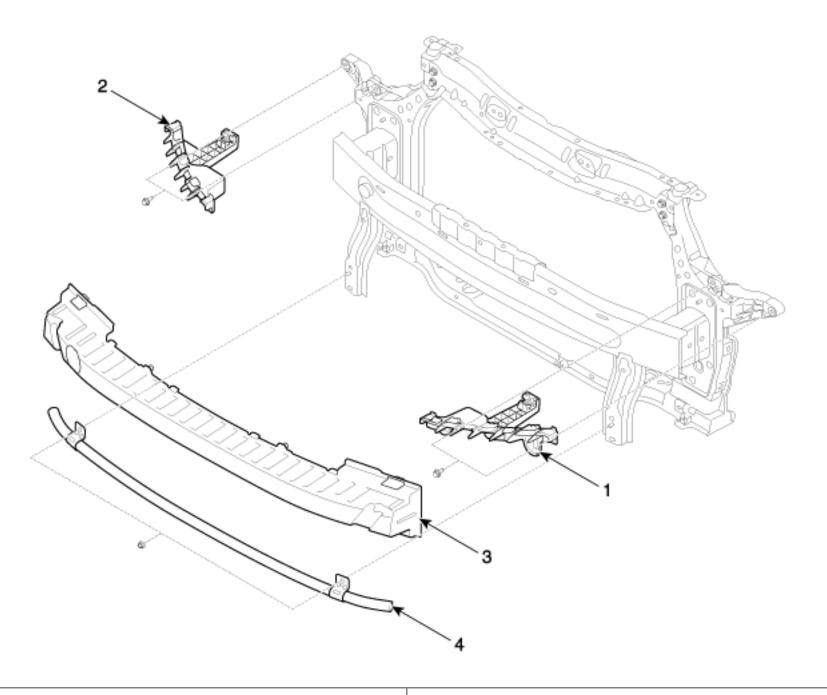
# **COMPONENTS (1)**



- 1. Front bumper cover
- 2. Front bumper side bracket [LH]

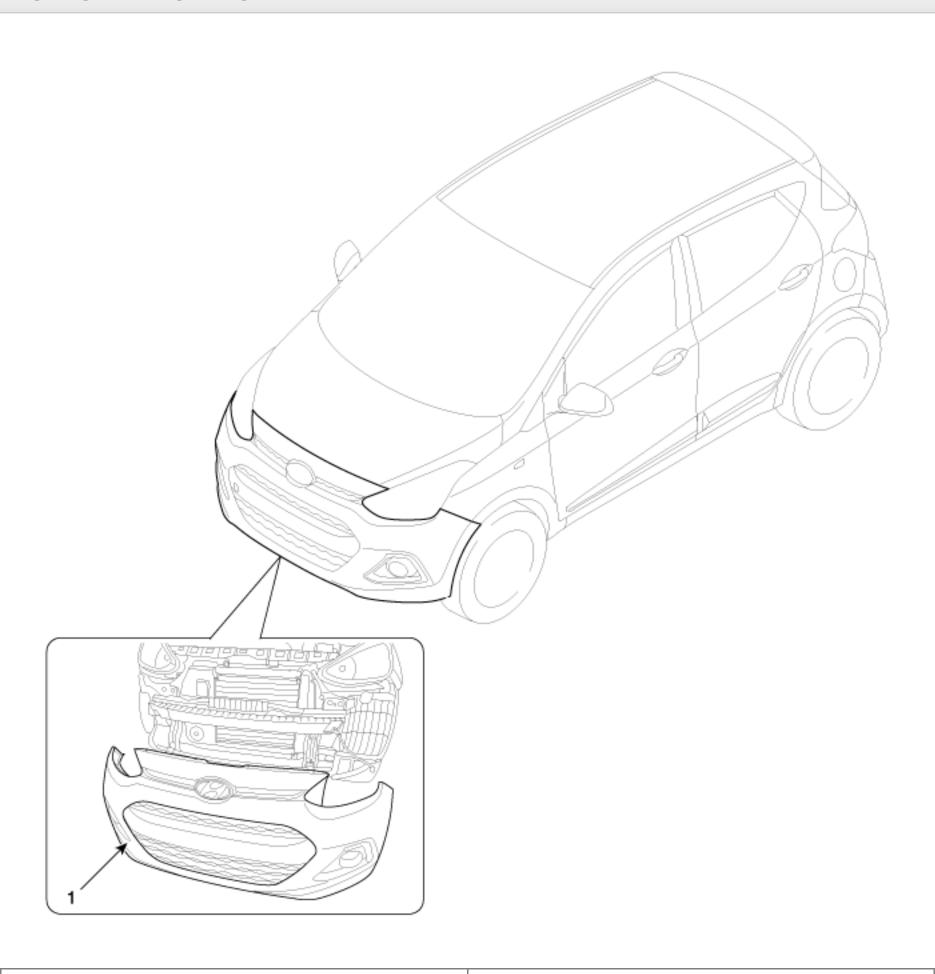
- 3. Front bumper side bracket [RH]
- 4. Front bumper uppper cover

# **COMPONENTS (2)**



- Front bumper side upper bracket [LH]
   Front bumper side upper bracket [RH]

- 3. Front bumper energy absober4. Front bumper lower stiffener



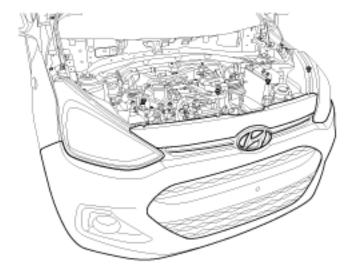
1. Front bumper cover

# **▲** CAUTION

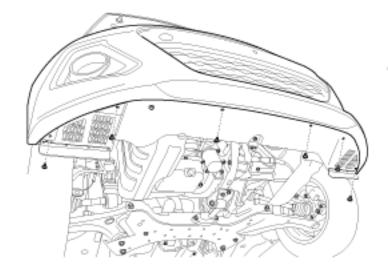
• Put on gloves to protect your hands.

### NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. Loosen the radiator upper cover mounting bolts and clips.



2. Loosen the front bumper lower mounting clips.



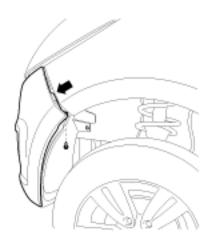
3. After loosening the front bumper side's mounting screw, then disconnect the side's.

# 1 Information

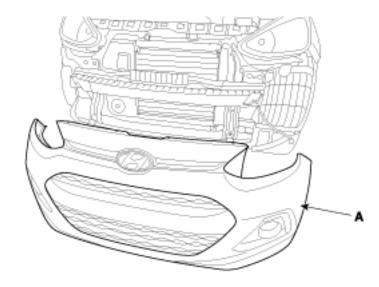
• Remove the front bumper by pulling up the side of the front bumper and then pull it out.



• When you pull out the front bumper, the side part of the front bumper could be damaged by the projection.



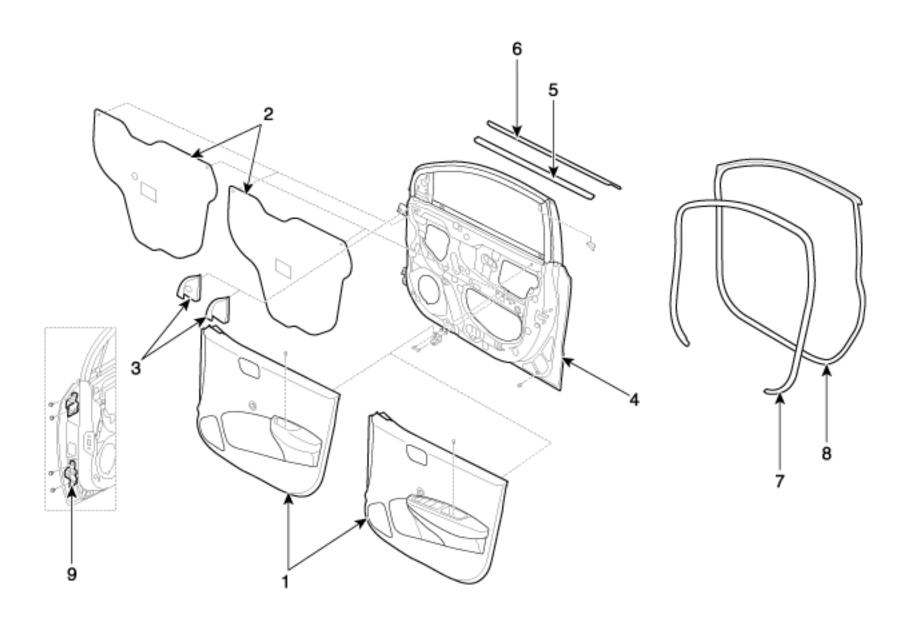
4. Remove the front bumper cover (A).



5. Install in the reverse order of removal.

## i Information

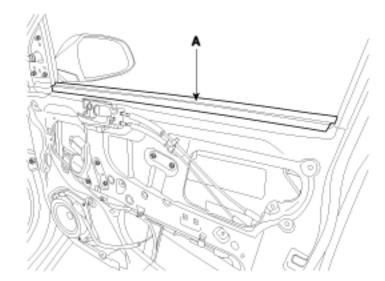
- Make sure the connector is plugged in properly.
- Replace any damaged clips.



- 1. Front door trim
- 2. Front door trim seal
- 3. Front door quadrant inner cover
- 4. Front door panel
- 5. Front door belt inside weatherstrip

- 6. Front door belt outside weatherstrip
- 7. Front door body side weatherstrip
- 8. Front door side weatherstrip
- 9. Front door hinge

- Remove the front door trim.
   (Refer to Front Door "Front Door Trim")
- 2. Remove the front door belt inside weatherstrip (A).

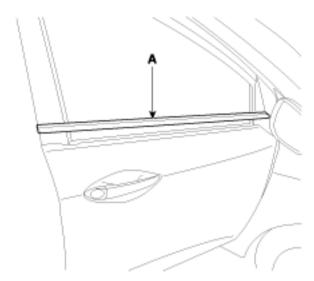


3. Install in the reverse order of removal.



• Replace any damaged clips.

- 1. Pull down front door window glass by pressing the power window glass switch.
- 2. Remove the front door belt outside weatherstrip (A).

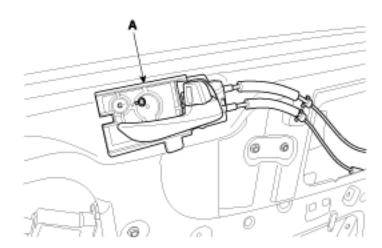


3. Install in the reverse order of removal.

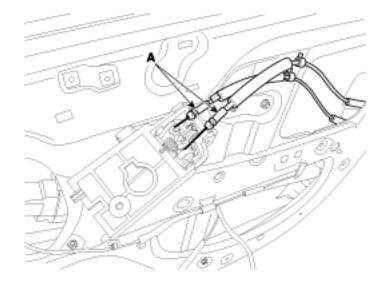


• Replace any damaged clips.

- Remove the front door trim.
   (Refer to Front Door "Front Door Trim")
- 2. After loosening the mounting screws, then remove the front door inside handle (A).



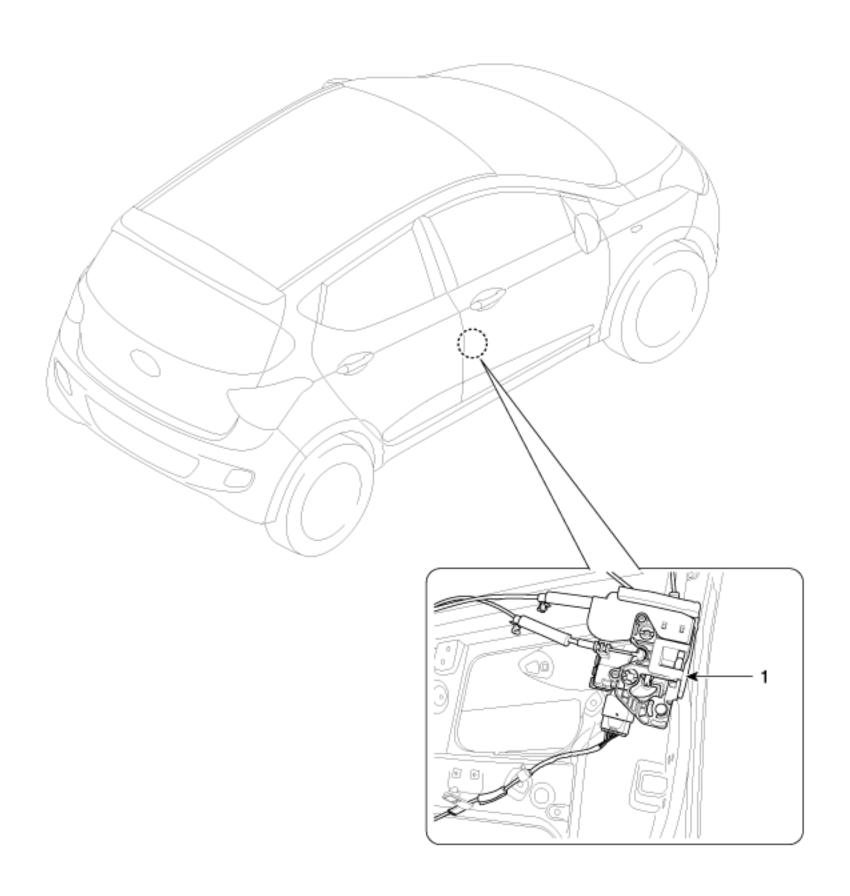
3. Disconnect the front door inside handle cable (A).



4. Install in the reverse order of removal.

## i Information

- Make sure the door locks/unlocks and opens/closes properly.
- Replace any damaged clips.



1. Front door latch

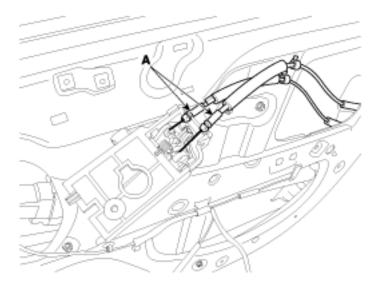
- 1. Pull up front door window glass by pressing the power window glass switch.
- Remove the front door trim.(Refer to Front Door "Front Door Trim")
- 3. After loosening the mounting screws, then remove the front door trim seal mounting bracket (A).
- 4. Remove the front door trim seal (B).

## NOTICE

· Replace any damaged door trim seal.



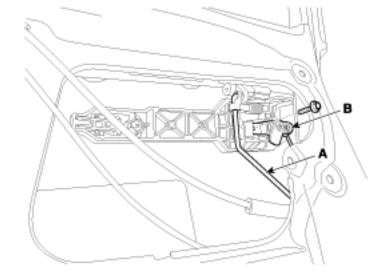
5. Disconnect the front door inside handle rod (A).



- 6. Disconnect the front door outside handle rod (A).
- 7. Separate the key holder rod (B) after removing the door lock lever by loosening its mounting bolt.

#### **Tightening torque:**

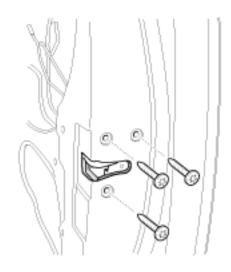
 $6.9 \sim 10.8 \text{ N.m} (0.7 \sim 1.1 \text{ kgf.m}, 5.1 \sim 8.0 \text{ lb-ft})$ 



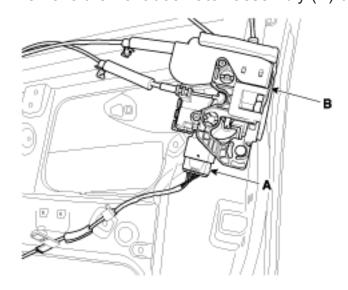
8. Loosen the front door latch mounting screws.

#### **Tightening torque:**

7.8 ~ 10.8 N.m (0.8 ~ 1.1 kgf.m, 5.8 ~ 8.0 lb-ft)



- 9. Disconnect the front door latch connector (A).
- 10. Remove the front door latch assembly (B) by pulling it in the direction of the arrow.

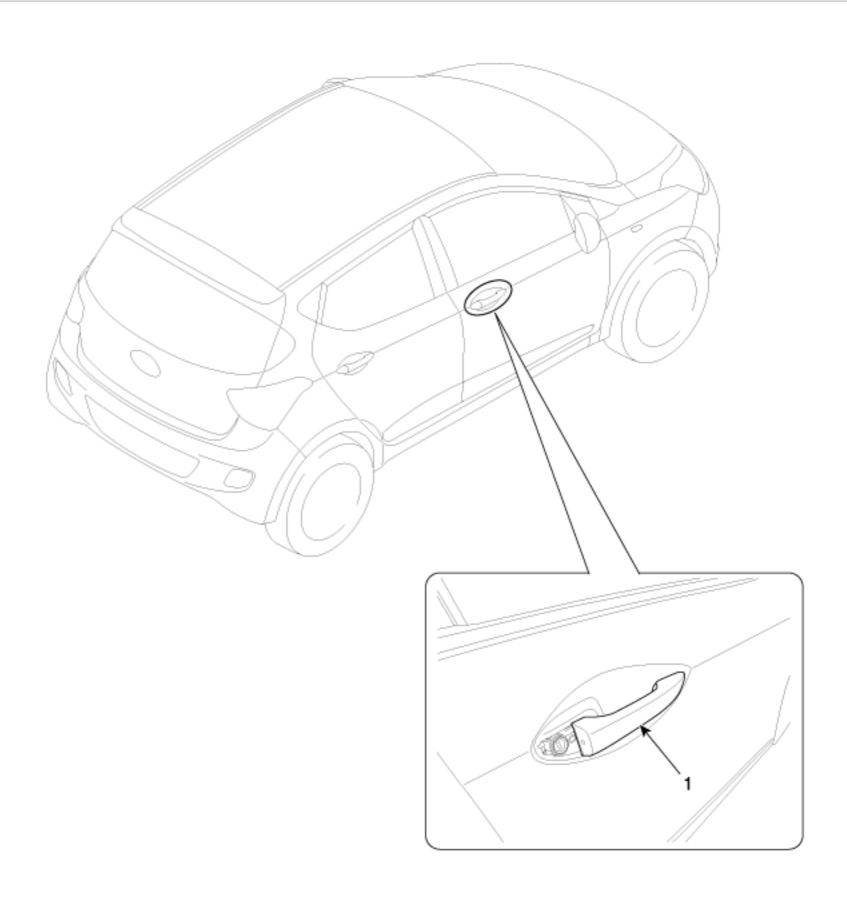


11. Install in the reverse order of removal.

## 1 Information

- Make sure the connector is connected properly.
- · Make sure the door locks/unlocks and opens/closes properly.
- Replace any damaged clips.

### **COMPONENT LOCATION**

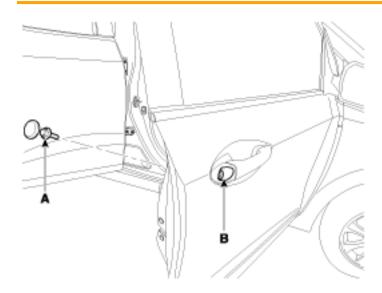


1. Front door outside handle

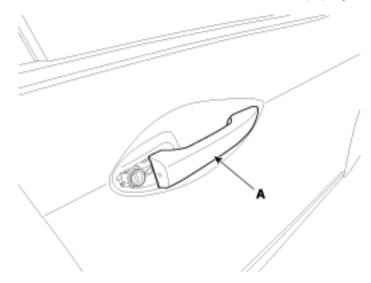
1. After loosening the mounting bolt (A), then remove the front door outside handle cover (B).

### Tightening torque:

7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.8 ~ 8.7 lb-ft)



2. Remove the front door outside handle (A) by sliding it rearward.

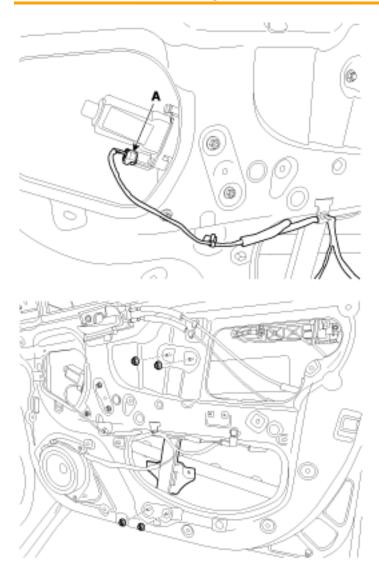


- 3. Install in the reverse order of removal.
  - Make sure the connector is connected properly.
  - Make sure the door locks/unlocks and opens/closes properly.

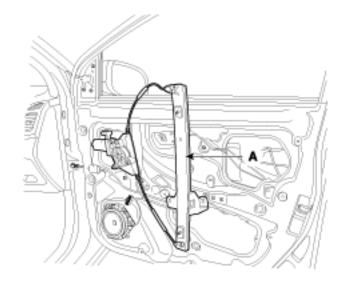
- Remove the front door window glass.
   (Refer to Front Door "Front Door Window Glass")
- 2. Disconnect the front door power window motor connector (A).
- 3. Loosen the front door power window regulator mounting nuts.

#### Tightening torque:

 $3.9 \sim 5.9 \text{ N.m} (0.4 \sim 0.6 \text{ kgf.m}, 2.9 \sim 4.3 \text{ lb-ft})$ 



4. Remove the front door power window regulator assembly (A).



- 5. Install in the reverse order of removal.
  - · Make sure the connector is connected properly.

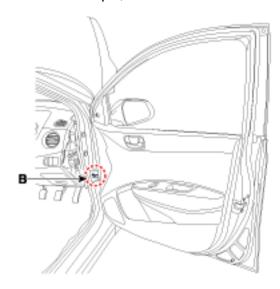
Make sure the door locks/unlocks and opens/closes properly.						

1. Loosen the front door checker (B) mounting bolt.

### **Tightening torque:**

6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)

2. Detach the clips, then remove the front door side weatherstrip (A).

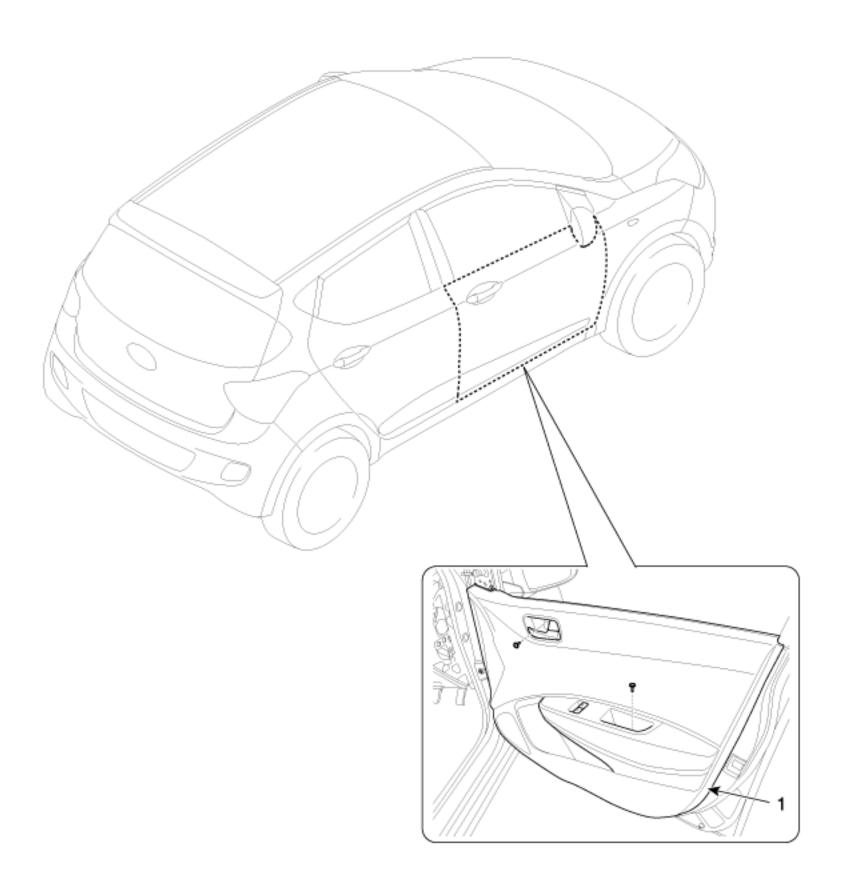


3. Install in the reverse order of removal.



• Replace any damaged clips.

# **COMPONENT LOCATION**



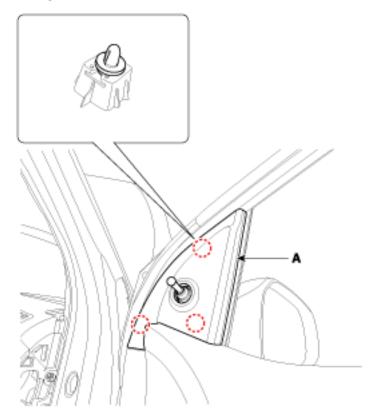
1. Front door trim

# **▲** CAUTION

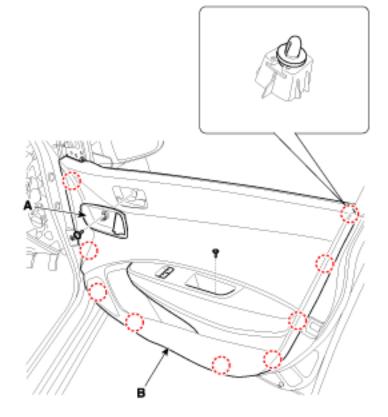
• Put on gloves to protect your hands.

## NOTICE

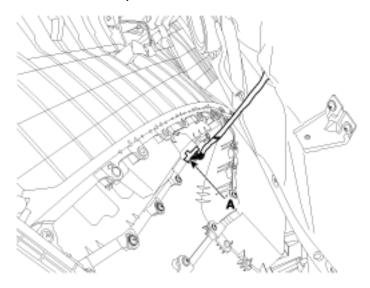
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Be careful not to scratch the door trim and other parts.
- 1. Using a screwdriver or remover, remove the front door quadrant inner cover (A).



- 2. After loosening the mounting screw, then remove the front door inside handle cover (A).
- 3. After loosening the mounting screw, then remove the front door trim (B).



4. Disconnect the power window switch connector (A).

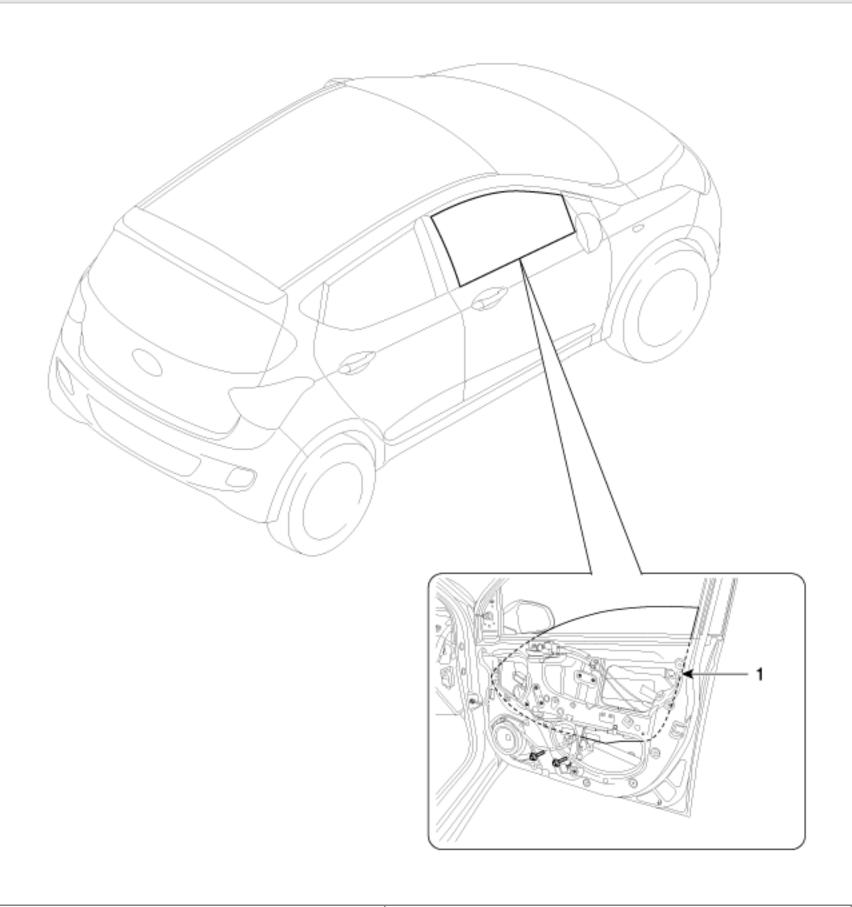


5. Install in the reverse order of removal.

# 1 Information

- Make sure the connector is connected properly.
- Make sure the door locks/unlocks and opens/closes properly.
- Replace any damaged clips.

# **COMPONENT LOCATION**

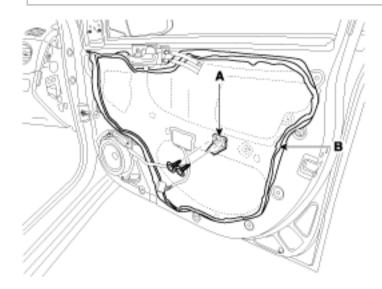


1. Front door window glass

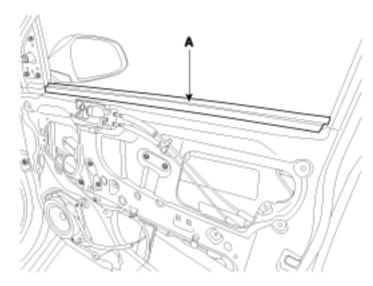
- Remove the front door trim.
   (Refer to Front Door "Front Door Trim")
- 2. After loosening the mounting screws, then remove the front door trim seal mounting bracket (A).
- 3. Remove the front door trim seal (B).

## NOTICE

• Replace any damaged door trim seal.



4. Remove the front door belt inside weatherstrip (A).



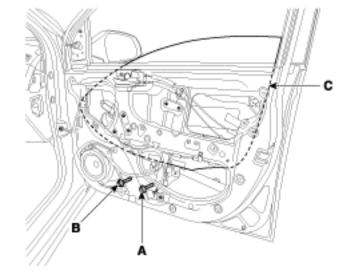
5. Before removing the front door glass (C), loosen the mounting bolt (A) as loosely as possible and loosen the mounting bolt (B) completely.

## **▲** CAUTION

• Take care not to drop to glass and scratch the glass surface.

### **Tightening torque:**

 $7.8 \sim 11.8 \text{ N.m} (0.8 \sim 1.2 \text{ kgf.m}, 5.8 \sim 8.7 \text{ lb-ft})$ 



6. Install in the reverse order of removal.

# 1 Information

- Roll the glass up and down to see if it moves freely without binding.
- Adjust glass position as needed.
- Replace any damaged clips.

### **ADJUSTMENT**

#### **Glass Adjustment**

## 1 Information

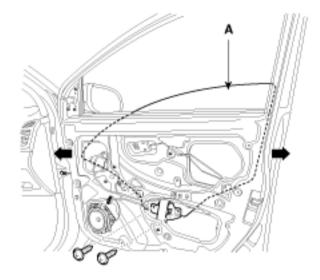
- Check the glass run channel for damage or deterioration, and replace them if necessary.
- Remove the front door trim.
   (Refer to Front Door "Front Door Trim")
- 2. After loosening the mounting screws, then remove the front door trim seal mounting bracket (A).
- 3. Remove the front door trim seal (B).

### NOTICE

- · Replace any damaged door trim seal.
- Vinyl tape of MS373-06 type must be applied along the tape line.
   (Bead length: Approximately. 2,285mm)



4. Carefully move the glass (A) until you can see the glass mounting bolts, then loosen them.



5. Check that the glass moves smoothly.

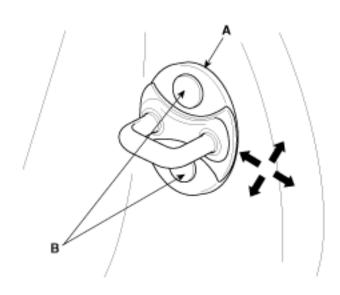
#### **Door Striker Adjustment**

## i Information

- Make sure the door latches securely without slamming it. If necessary adjust the striker (A): The striker nuts are fixed. The striker can be fine adjusted up or down, and in or out.
- Adjust the striker center. (Max. ±1.5mm)
- 1. Loosen the screws (B) just enough for the striker to move.

#### **Tightening torque:**

(B): 16.7 ~ 21.6 N.m (1.7 ~ 2.2 kgf.m, 12.8 ~ 15.9 lb-ft)

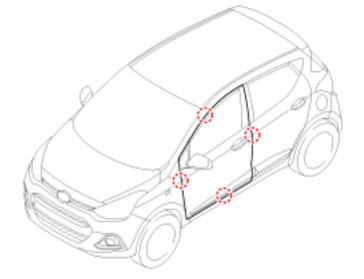


- 2. Tap on the striker with a plastic hammer to adjust the striker. The striker will not move much, but will give some adjustment.
- 3. Hold the outer handle out, and push the door against the body to be sure the striker allows a flush fit. If the door latches properly, tighten the screws and recheck.

### **Door Position Adjustment**

# i Information

- After installing the door, check for a flush fit with the body, then check for equal gaps between the front, rear, and bottom, door edges and the body. Check that the door and body edges are parallel. Before adjusting, replace the mounting bolts.
- 1. Check that the door and body edges are parallel.



2. Place the vehicle on a firm, level surface when adjusting the doors.

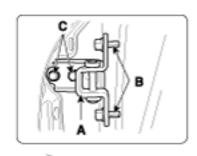
### 3. Adjust at the hinges (A):

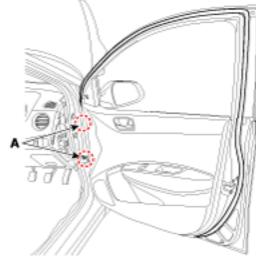
- Loosen the door mounting bolts slightly, and move the door in or out until it aligns flush with the body.
- Loosen the hinge mounting bolts slightly, and move the door backward or forward, up or down as necessary to equalize the gaps.
- Place a shop towel on the jack to prevent damage to the door when adjusting the door.

### **Tightening torque:**

(B): 21.6 ~ 26.5 N.m (2.2 ~ 2.7 kgf.m, 15.9 ~ 19.5 lb-ft)

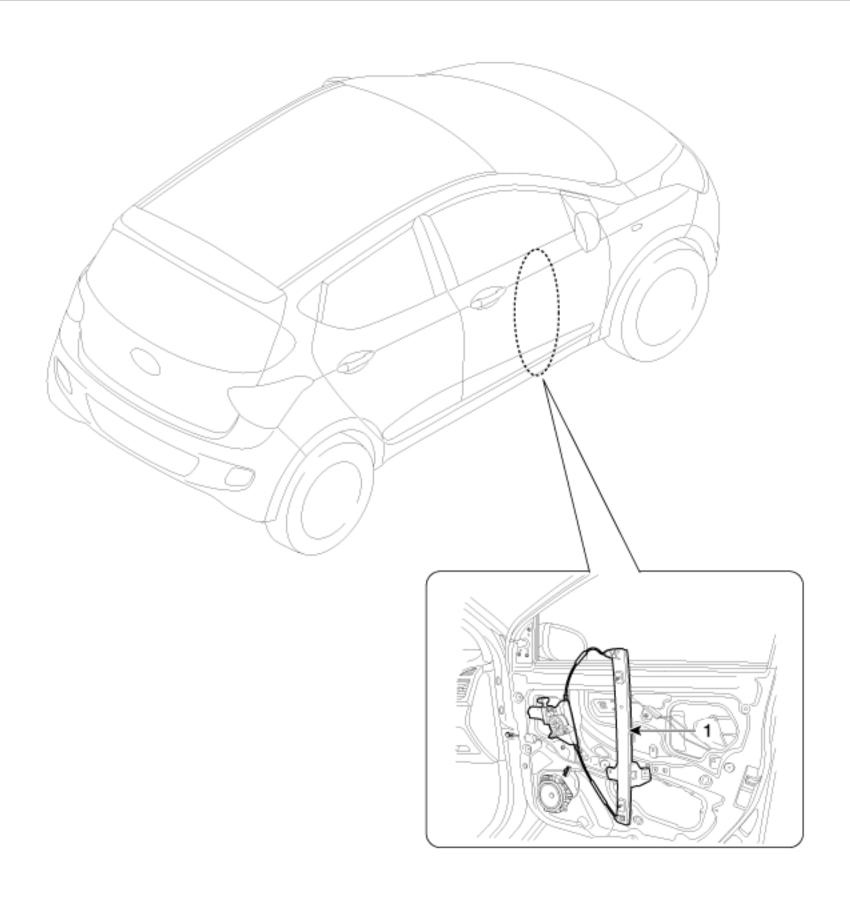
(C): 37.3 ~ 41.2 N.m (3.8 ~ 4.2 kgf.m, 27.5 ~ 30.4 lb-ft)





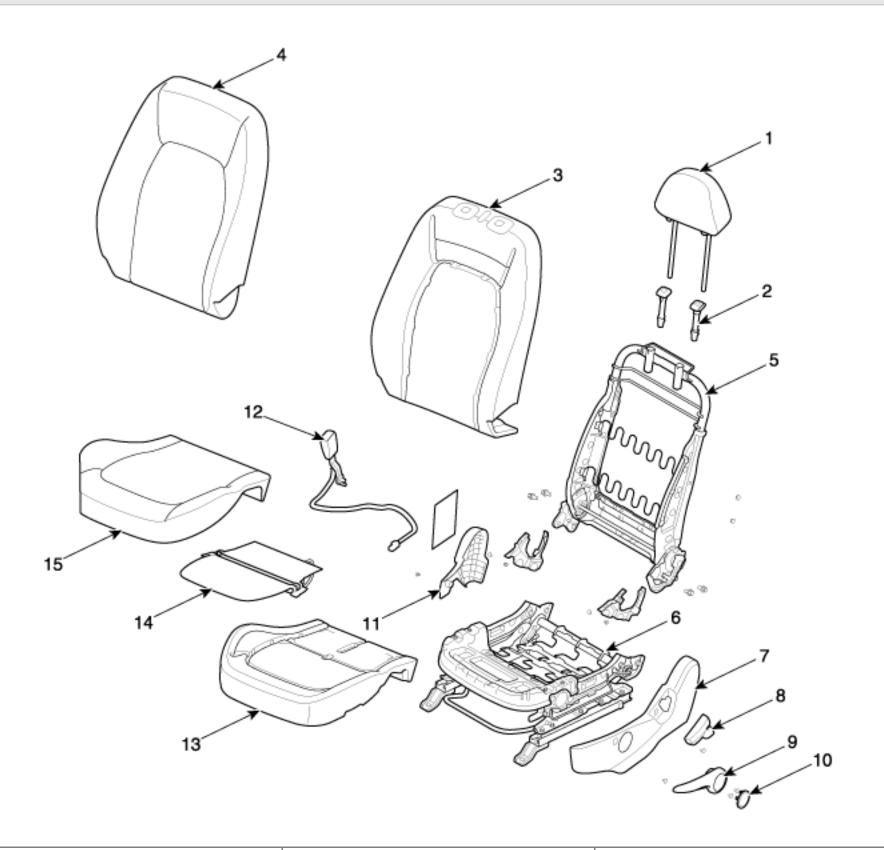
- 4. Grease the pivot portions of the hinges indicated.
- 5. Check for water leaks.

# **COMPONENT LOCATION**



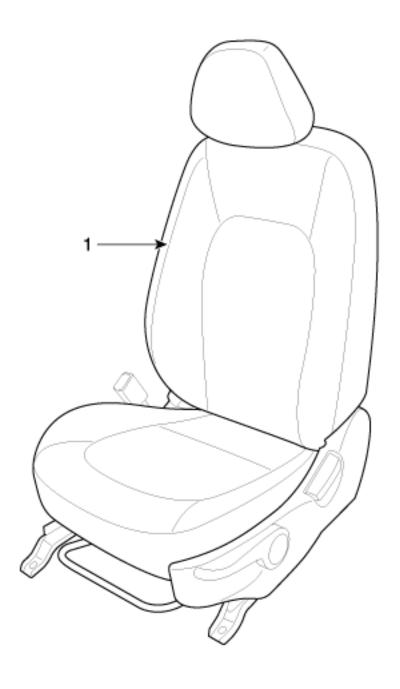
1. Front door power window regulator

### **COMPONENTS**



- 1. Front seat headrest
- 2. Front seat headrest guide
- 3. Front seat back pad
- 4. Front seat back cover
- 5. Front seat back frame assembly
- 6. Front seat cushion frame assembly
- 7. Front seat shield outer cover
- 8. Front seat recliner lever
- 9. Height lever
- 10. Height lever cap

- 11. Front seat shield inner cover
- 12. Front seat belt buckle
- 13. Front seat cushion pad
- 14. Front seat cushion silener cloth
- 15. Front seat cushion cover

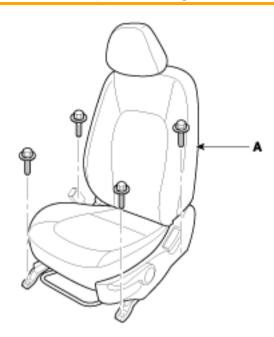


1. Front seat assembly

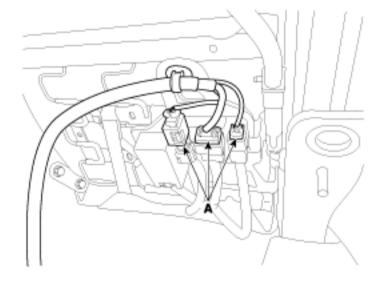
1. After loosening the mounting bolts, remove the front seat assembly (A).

#### **Tightening torque:**

34.3 ~ 53.9 N.m (3.5 ~ 5.5 kgf.m, 25.3 ~ 39.8 lb-ft)



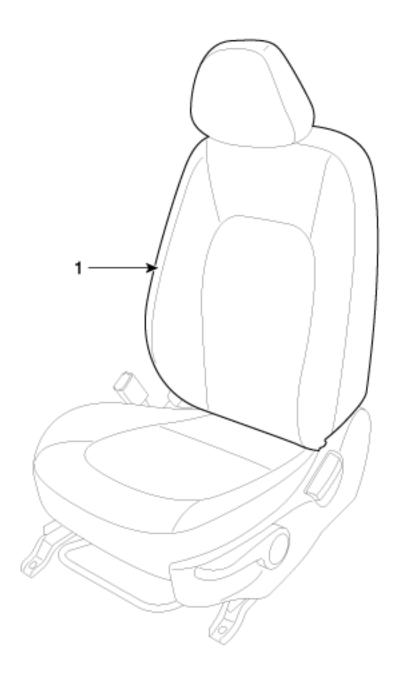
Disconnect the front seat connector (A).[Driver's]



3. Install in the reverse order of removal.

## i Information

- Set the seat into the most rearward position. Check that each slide is locked, and then tighten the front mounting bolt temporarily.
- Set the seat into most forward position. Check that each slide is locked, and then Tighten the rear mounting bolt completely.
- Set the seat into the most rearward position. Check the front mounting bolt completely.
- Check that the seat operates to and fro smoothy and the locking portion locks properly.



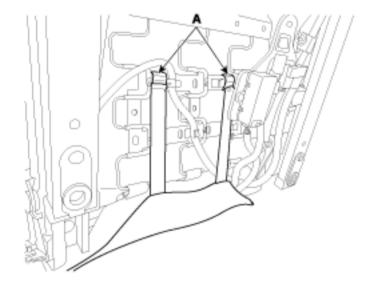
1. Front seat back cover

## **▲** CAUTION

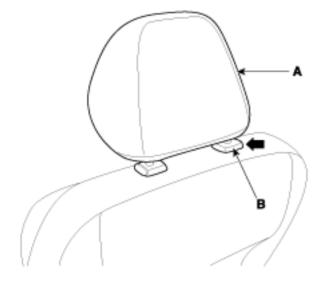
• Put on gloves to protect your hands.

### **NOTICE**

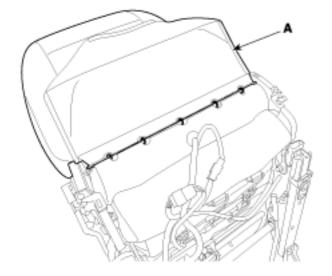
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the front seat assembly.
   (Refer to Front Seat "Front Seat Assembly")
- Remove the front seat shield outer cover.
   (Refer to Front Seat "Front Seat Shield Outer Cover")
- Remove the front seat shield inner cover.
   (Refer to Front Seat "Front Seat Shield Inner Cover")
- 4. Remove the front seat lower protector (A).



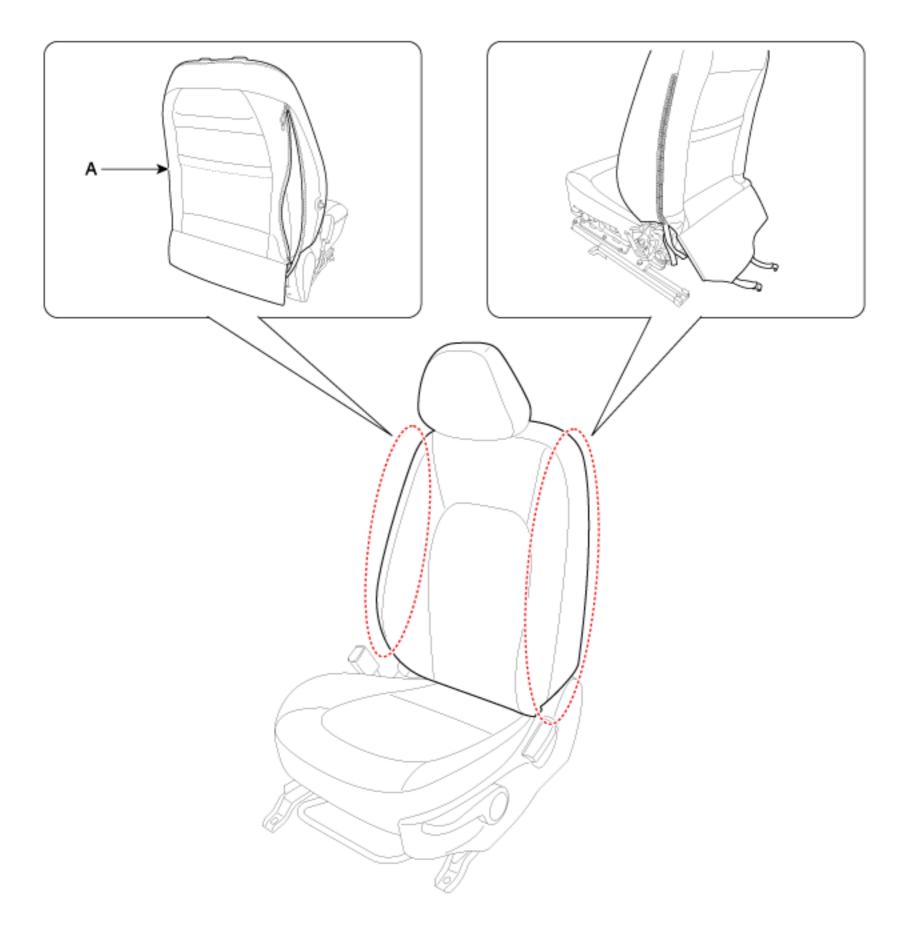
5. Push the lock pin (B), remove the front seat headrest (A).



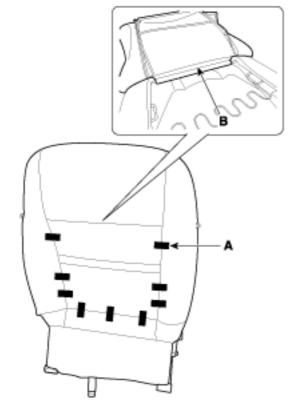
6. Remove the hog-ring clips (A) located in the rear lower side of front seat back cover.



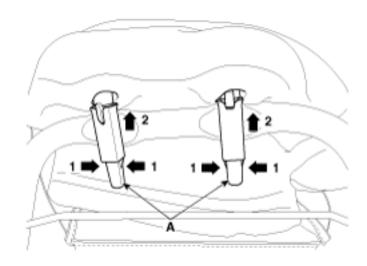
7. Zip off the front seat back cover (A), and then pull it up.



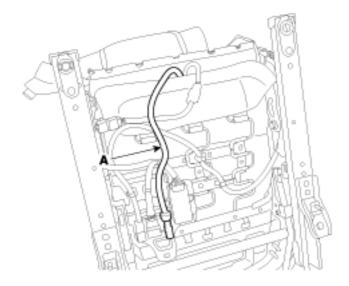
- 8. Remove the hog-ring clips (A) located in the rear lower side of front seat back cover.
- 9. Pull out the protecter (B) by the front seat back frame.



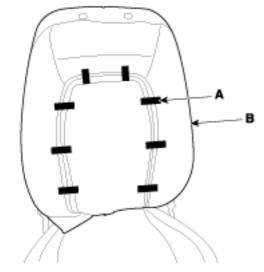
10. Turn the front seat back cover inside out. pull out the headrest guides (A) while pinching both side of the lower part of the guides, and remove them.



11. Disconnect the Connector wiring (A).



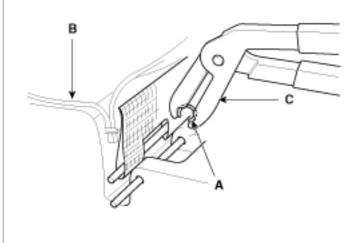
12. Remove the hog-ring clips (A) located in the rear lower side of front seat back cover (B).

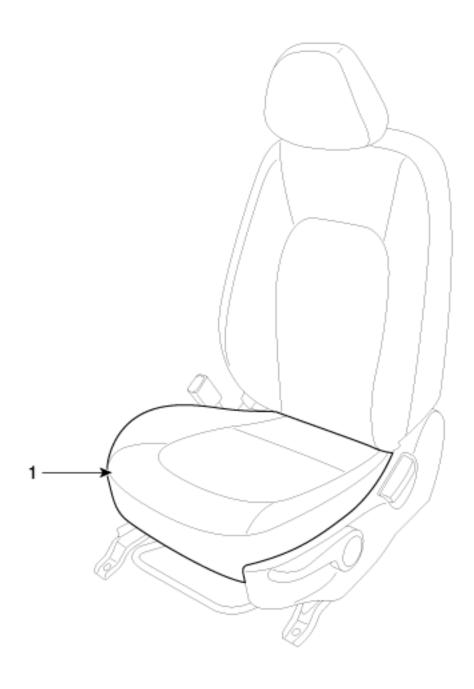


13. Install in the reverse order of removal.

# i Information

- To prevent wrinkles, make sure the material is stretched evenly over the cover (B) before securing the hogring clips (A).
- Replace the hog-ring clips with new ones using special tool (C) (09880-4F000).





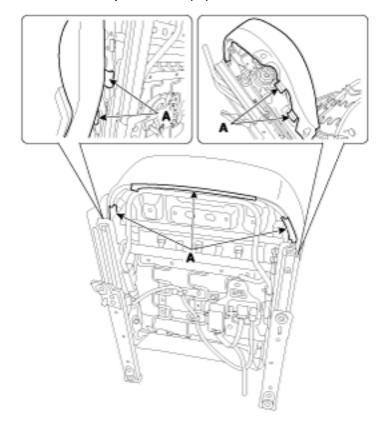
1. Front seat cushion cover

## **▲** CAUTION

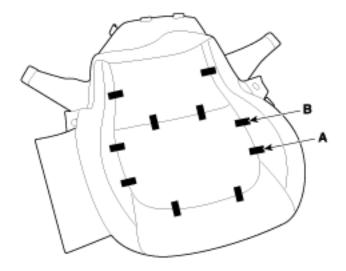
Put on gloves to protect your hands.

### NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the front seat assembly.
   (Refer to Front Seat "Front Seat Assembly")
- Remove the front seat shield outer cover. (Refer to Front Seat - "Front Seat Shield Outer Cover")
- Remove the front seat shield inner cover.
   (Refer to Front Seat "Front Seat Shield Inner Cover")
- 4. Remove the protector (A).



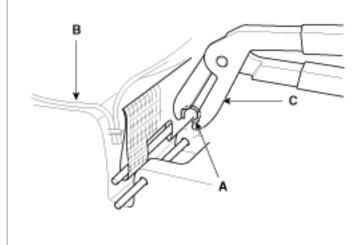
- 5. Remove the front seat cushion cover from the front seat frame.
- 6. After removing the hog-ring clips (B) on the front of seat cushion and remove the front seat cushion cover (A).

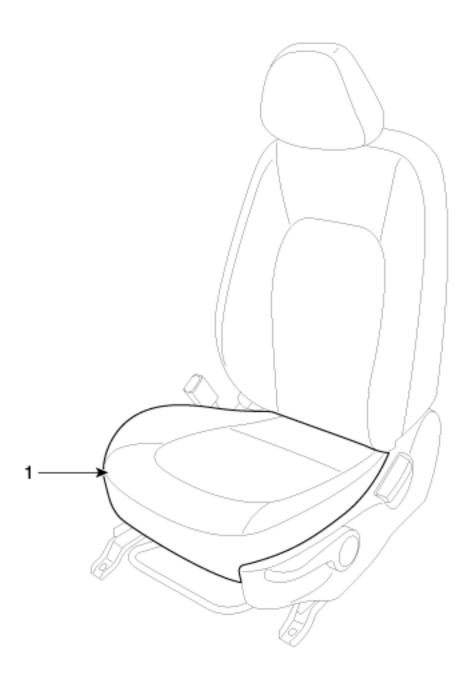


7. Install in the reverse order of removal.

## 1 Information

- To prevent wrinkles, make sure the material is stretched evenly over the cover (B) before securing the hog-ring clips (A).
- Replace the hog-ring clips with new ones using special tool (C) (09880-4F000).





1. Front seat back frame assembly

2. Front seat cushion frame assembly

### **▲** CAUTION

• Put on gloves to protect your hands.

### NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the front seat back cover.
   (Refer to Front Seat "Front Seat Back Cover")
- Remove the front seat cushion cover. (Refer to Front Seat - "Front Seat Cushion Cover")
- Remove the front seat belt buckle.
   (Refer to Front Seat Belt "Front Seat Belt Buckle")
- 4. After loosening the mounting bolts, then disconnect the front seat back frame assembly (A) and front seat cushion frame assembly (B).

#### Tightening torque:

44.1 ~ 53.9 N.m (4.5 ~ 5.5 kgf.m, 32.5 ~ 39.8 lb-ft)

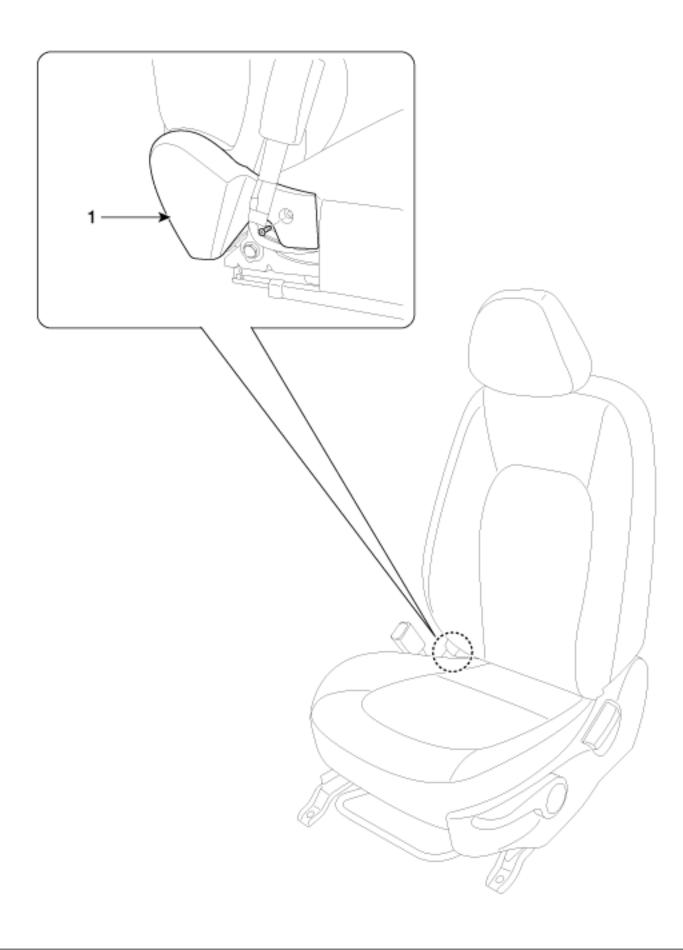


5. Install in the reverse order of removal.

# i Information

- Remove the side air bag for replacing side air bag installation seat.
   (Refer to Restraint "Side Airbag (SAB) Module")
- Before service, be fully aware of precautions and service procedure relevant to air bag.
   (Refer to Restraint "Side Airbag (SAB) Module")

# **COMPONENT LOCATION**



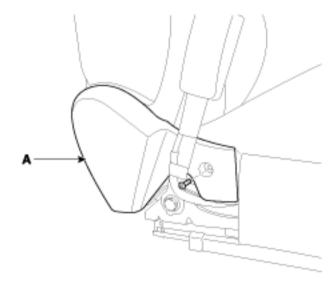
1. Front seat shield inner cover

## **▲** CAUTION

• Put on gloves to protect your hands.

## NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the front seat assembly.
   (Refer to Front Seat "Front Seat Assembly")
- 2. After loosening the mounting screw, then remove the front seat shield inner cover (A).



3. Install in the reverse order of removal.

## information

Replace any damaged clips.



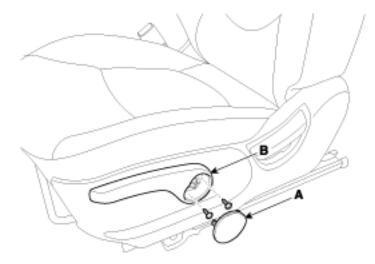
1. Front seat shield outer cover

# **▲** CAUTION

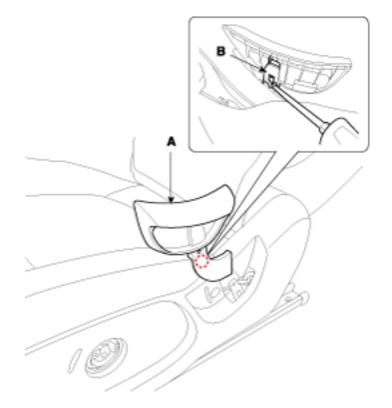
• Put on gloves to protect your hands.

## NOTICE

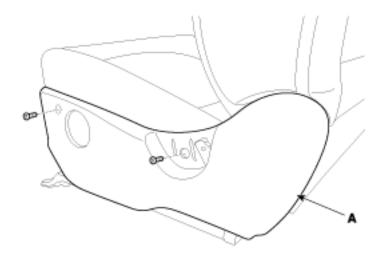
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the front seat assembly.
   (Refer to Front Seat "Front Seat Assembly")
- 2. Remove the height cap (A).
- 3. After loosening the mounting screws, then remove the height knob (B).



4. To remove the recliner handle (A), and then remove the recliner handle after pushing the lock pin (B).



5. After loosening the mounting screws, then remove the front outer shield cover (A).

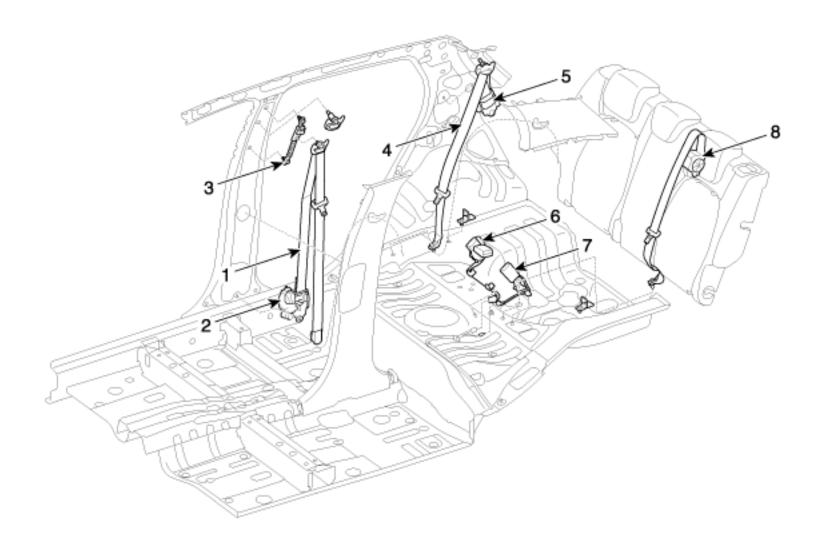


6. Install in the reverse order of removal.



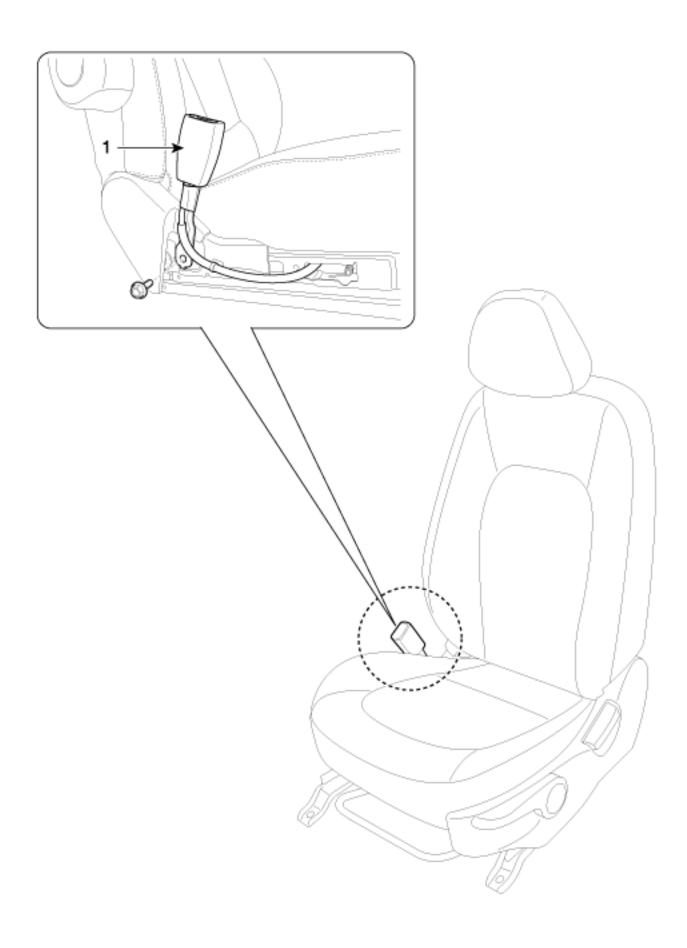
• Replace any damaged clips.

# **COMPONENTS**



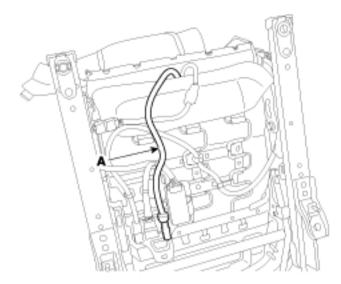
- 1. Front seat belt
- 2. Front seat belt pretensioner
- 3. Height adjuster
- 4. Rear seat belt

- 5. Rear seat belt retractor
- 6. Rear seat belt buckle [RH]
- 7. Rear seat belt buckle [LH]
- 8. Rear center seat belt retractor



1. Front seat belt buckle

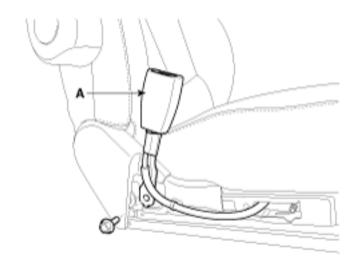
- Remove the front seat assembly.
   (Refer to Front Seat "Front Seat Assembly")
- 2. Disconnect the front seat belt buckle connector wiring (A).



3. After loosening the mounting bolt, then remove the front seat belt buckle (A).

### **Tightening torque:**

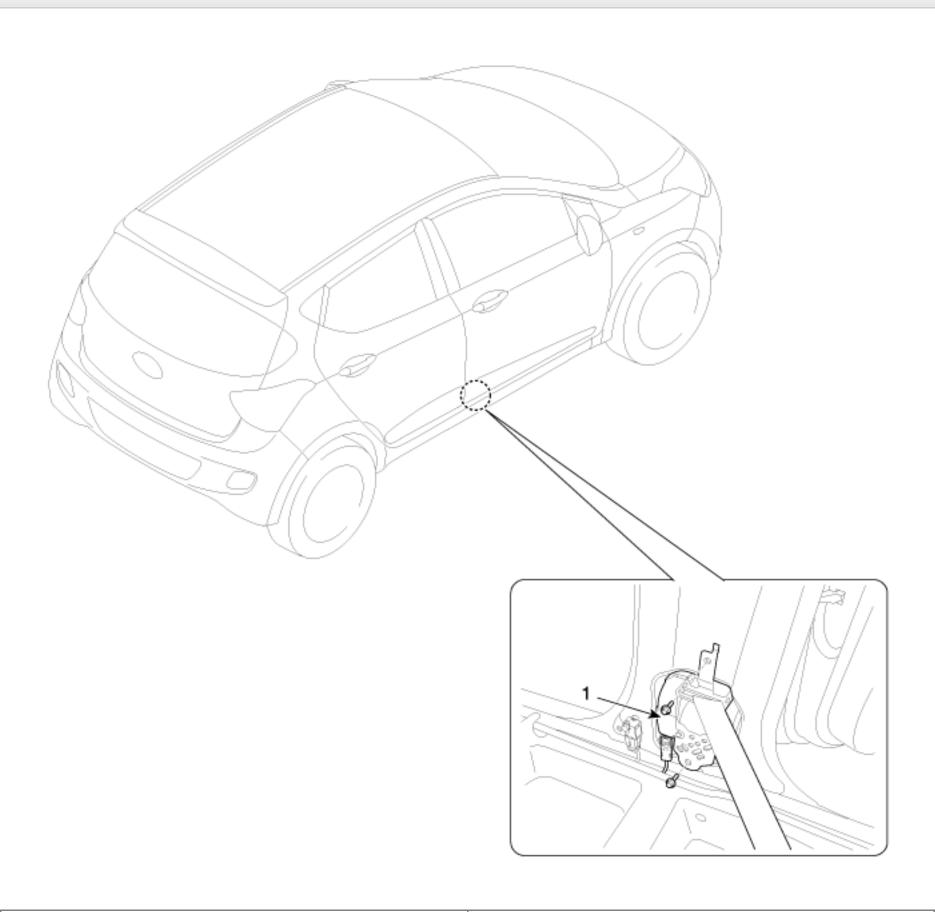
39.2 ~ 53.9 N.m (4.0 ~ 5.5kgf.m, 28.9 ~ 39.8 lb-ft)



4. Install in the reverse order of removal.

# information

- Make sure the connector is plugged in properly.
- Replace any damaged clips.



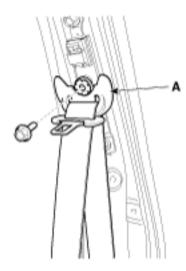
1. Front seat belt pretensioner

### **NOTICE**

- When installing the belt, make sure not to damage the pretensioner.
- Remove the center pillar upper trim.
   (Refer to Interior Trim "Center Pillar Trim")
- 2. After loosening the mounting bolt, then remove the front seat belt upper anchor (A).

### **Tightening torque:**

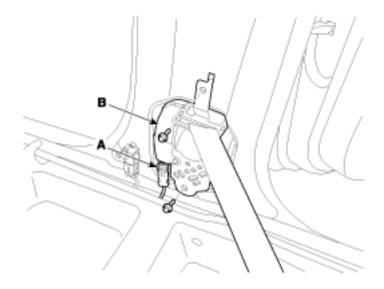
39.2 ~ 53.9 N.m (4.0 ~ 5.5 kgf.m, 28.8 ~ 39.8 lb-ft)



3. After disconnecting the lock pin, remove the front seat belt pretensioner connector (A), loosen the mounting bolt, then remove the front seat belt pretensioner (B).

#### **Tightening torque:**

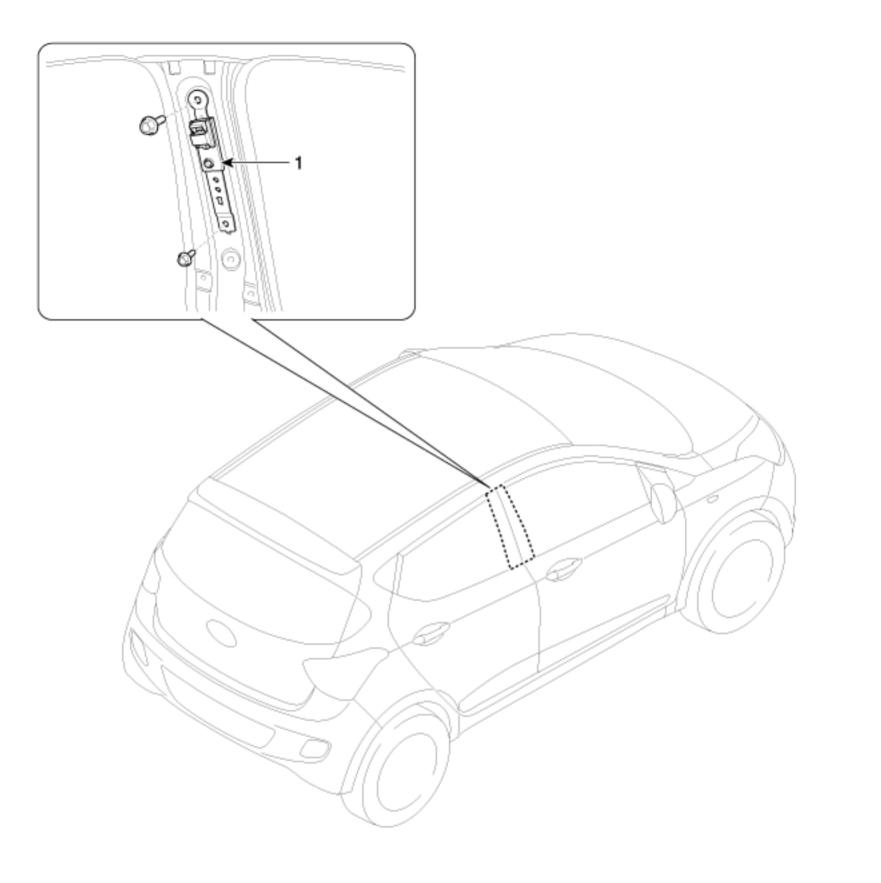
39.2 ~ 53.9 N.m (4.0 ~ 5.5 kgf.m, 28.8 ~ 39.8 lb-ft)



4. Install in the reverse order of removal.

# information

- Make sure the connector is plugged in properly.
- Replace any damaged clips.

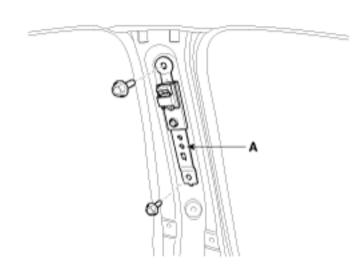


1. Height adjust

- Remove the front seat belt upper anchor.
   (Refer to Front Seat Belt "Front Seat Belt Pretensioner")
- 2. After loosening the mounting bolts, then remove the height adjust (A).

### **Tightening torque:**

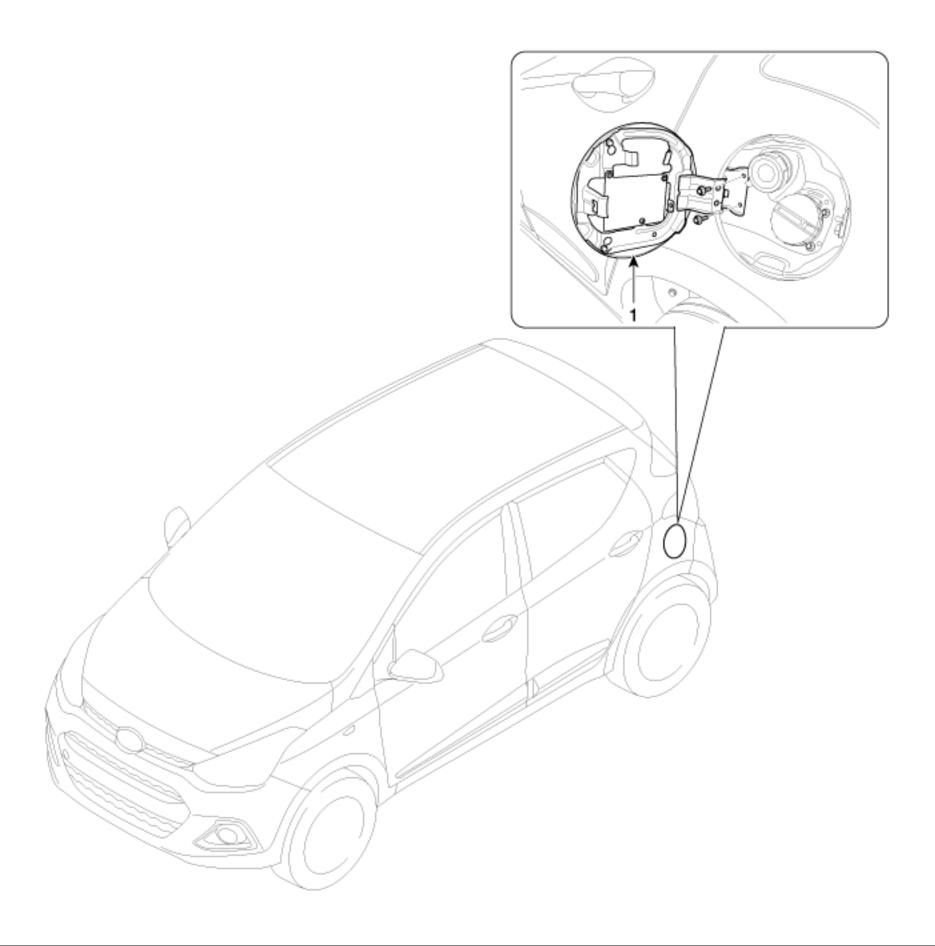
39.2 ~ 53.9 N.m (4.0 ~ 5.5kgf.m, 28.9 ~ 39.8 lb-ft)



3. Install in the reverse order of removal.

# i Information

• Replace any damaged clips.



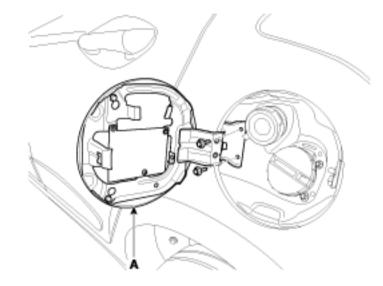
1. Fuel filler door

# **▲** CAUTION

• Put on gloves to protect your hands.

# NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- 1. Open the fuel filler door.
- 2. After loosening the mounting bolts, then remove the fuel filler door (A).



3. Install in the reverse order of removal.

# i Information

• Make sure the fuel filler door locks/unlocks and opens/closes properly.

### **SPECIAL SERVICE TOOLS**

Tool (Number and name)	Illustration	Use
09880-4F000 Hog ring clip installer		Hog ring clip installation

SPECIFICATIONS					
	Items		Spec	cification	
Hood	Туре	Rear hinged, front opening type			
Front Door	Construction	Front hinged, full door construction			
	Regulator system	Wire drum type			
	Locking system	Pin-fork sys	stem		
Rear Door	Construction	Front hinged, full door construction			
	Regulator system	Wire drum type			
	Locking system	Pin-fork sys	stem		
Tail Gate	Туре	Front hinge	ed, gas lifter type		
Seat Belts	Front	3 point type with Emergency Locking Retractor (E.L.R) 3 point type with Emergency Locking Retractor (E.L.R)		ctor (E.L.R)	
	Rear			ctor (E.L.R)	
TIGHTENING TO	RQUE				
	Items		N.m	Kgf.m	lb-ft
Front and rear doors	Door hinge to body		37.3 ~ 41.2	3.8 ~ 4.2	27.5 ~ 30.4
	Door hinge to door		21.6 ~ 26.5	2.2 ~ 2.7	15.9 ~ 19.5
	Door checker to door		6.9 ~ 10.8	0.7 ~ 1.1	5.1 ~ 8.0
Door checker to body			21.6 ~ 32.4	2.2 ~ 3.3	15.9 ~ 23.9
	Door glass mounting bolt		7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
	Door division channel mounting screw		4.0 ~ 5.0	0.4 ~ 0.5	2.9 ~ 3.6
Outside handle base mounting bolt		lt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
	Door channel mounting bolts		3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
					<del></del>

 $6.9 \sim 10.8$ 

7.8 ~ 10.8

3.9 ~ 5.9

16.7 ~ 21.6

21.6 ~ 26.5

21.6 ~ 26.5

6.9 ~ 10.8

21.6 ~ 26.5

21.6 ~ 26.5

21.6 ~ 26.5

6.9 ~ 10.8

34.3 ~ 53.9

44.1 ~ 53.9

 $0.7 \sim 1.1$ 

0.8 ~ 1.1

 $0.4 \sim 0.6$ 

 $1.7 \sim 2.2$ 

2.2 ~ 2.7

2.2 ~ 2.7

 $0.7 \sim 1.1$ 

2.2 ~ 2.7

 $2.2 \sim 2.7$ 

2.2 ~ 2.7

 $0.7 \sim 1.1$ 

 $3.5 \sim 5.5$ 

4.5 ~ 5.5

5.1 ~ 8.0

5.8 ~ 8.0

2.9 ~ 4.3

12.3 ~ 15.9

15.9 ~ 19.5

15.9 ~ 19.5

5.1 ~ 8.0

15.9 ~ 19.5

15.9 ~ 19.5

15.9 ~ 19.5

5.1 ~ 8.0

25.3 ~ 39.8

32.5 ~ 39.8

Hood

Seat

	Items
Front and rear doors	Door hinge to body
	Door hinge to door
	Door checker to door
	Door checker to body
	Door glass mounting bolt
	Door division channel mountin
	Outside handle base mounting
	Door channel mounting bolts
	Door key holder rod bolt
	Door latch mounting bolts
	Door regulator mounting nuts
	Door striker mounting bolts
Tail gate	Tail gate hinge to body
	Tail gate hinge to tail gate
	Tail gate latch mounting bolts

Tail gate striker mounting bolts

Hood hinge to body

Hood hinge to hood

Hood latch to body

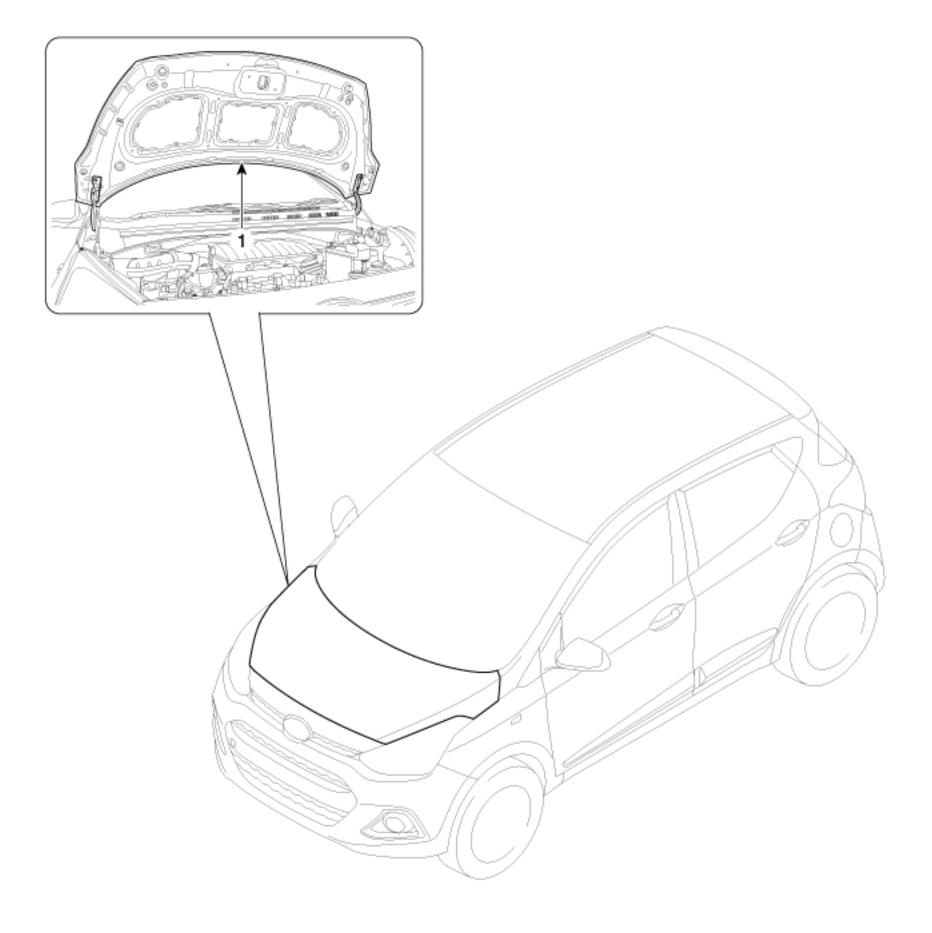
Front seat mounting bolts

Front seat frame mounting bolts

	Front seat cushion track mounting bolts	44.1 ~ 53.9	4.5 ~ 5.5	32.5 ~ 39.8
	Rear seat mounting bolts	16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8
	Rear seat back mounting bolts	19.6 ~ 29.4	2.0 ~ 3.0	14.5 ~ 21.7
	Rear seat latch mounting bolts	16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8
Seat belt	Height adjuster mounting bolts	39.2 ~ 53.9	4.0 ~ 5.5	28.9 ~ 39.8
	Front seat belt upper anchor mounting bolt	39.2 ~ 53.9	4.0 ~ 5.5	28.9 ~ 39.8
	Front seat belt pretensioner mounting bolt	39.2 ~ 53.9	4.0 ~ 5.5	28.9 ~ 39.8
	Rear seat belt lower anchor mounting bolts	39.2 ~ 53.9	4.0 ~ 5.5	28.9 ~ 39.8
	Rear seat belt retractor mounting bolt	39.2 ~ 53.9	4.0 ~ 5.5	28.9 ~ 39.8
	Rear center seat belt retractor nut	39.2 ~ 53.9	4.0 ~ 5.5	28.9 ~ 39.8
	Seat belt buckle mounting bolt	39.2 ~ 53.9	4.0 ~ 5.5	28.9 ~ 39.8
Outside rearview mirror	Outside rearview mirror mounting nuts	6.9 ~ 10.8	0.7 ~ 1.1	5.1 ~ 8.0
Wiper arm	Wiper arm mounting nuts	22.6 ~ 26.5	2.3 ~ 2.7	16.6 ~ 19.5
Sunroof	Panorama Sunroof mounting bolts	6.9 ~ 10.8	0.7 ~ 1.1	5.1 ~ 8.0

# **TROUBLESHOOTING**

Symptom	Suspect Area	Remedy (Refer to page)	
Water leaks from sunroof	Dirt accumulated in drain tube	Clear dirt inside of drain	
	Clogged drain tube	Blow air into drain to remove dirt	
	Broken or dislocated drain tube, defective or cracked clip	Check tube installation and flange contact	
	Deteriorated roof lid weatherstrip	Replace	
	Excessive roof lid-to-body clearance and improperly fitted weatherstrip	Adjust	
Wind noise around sunroof	Loosen or deformed deflector, gaps in body work	Retighten adjust or replace	
Sunroof lid makes a noise when move	Foreign particles lodged in guide rail	Check drive cable and guide rails for foreign particles	
	Loosen guide rails and lid	Retighten	
Motor runs but sunroof does not move or moves only partially	Foreign particles lodged in guide rail	Adjust or replace	
	Incorrect engagement of motor pinion with drive cable	_	
	Decrease in motor's clutch slipping force		
	Increased sunroof sliding resistance or interference of sunroof with drive cables, weatherstrip, etc. due tomal adjustment of sunroof		
Noise in motor (clutch slipping	Incorrect engagement of motor pinion with drive	Check pinion installation and	
noise from motor when sunroof is	cable	Re-tighten motor	
fully opened or closed is not an unusual noise	Worn out or damaged motor pinion bearing	Replace motor assembly	
	Worn out or deformed drive cable	Replace	
Door glass fails to operate up and	Incorrect window glass installation	Adjust position	
down	Damaged or faulty regulator arm or regulator	Correct or replace	
Door does not open or close	Incorrect door installation	Adjust position	
completely	Defective door check assembly	Correct or replace	
	Door hinge requires grease	Apply grease	
Hood does not open or close completely	Striker and latch not properly aligned	Adjust	
	Incorrectly installed hood Adjust		
	Incorrect hood bumper height Adjust		
Water leak through windshield end	Defective seal Fill with sealant		
rear window	Defective flange Correct		



1. Hood assembly

### NOTICE

• Be careful not to damage the hood and body.

# 1 Information

- When removing and installing the hood, an assistant is necessary.
- When removing the clips, use a clip remover.
- 1. After loosening the hood hinge (B) mounting bolts, remove the hood assembly (A).

### **Tightening torque:**

21.6 ~ 26.5 N.m (2.2 ~ 2.7 kgf.m, 15.9 ~ 19.5 lb-ft)



2. Install in the reverse order of removal.

# i Information

- Make sure the hood locks/unlocks and opens/closes properly.
- · Adjust the hood alignment.

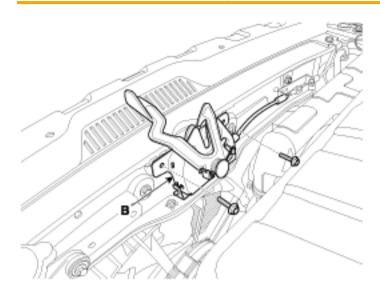


1. Hood lower latch assembly

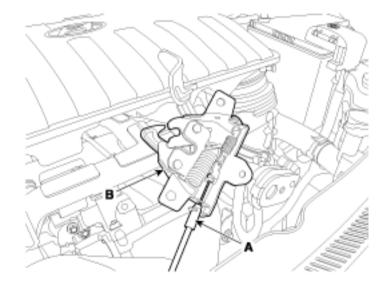
- 1. Disconnect the hood lower latch connector (A).
- 2. Remove the hood lower latch assembly (B) mounting bolts.

### **Tightening torque:**

6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)



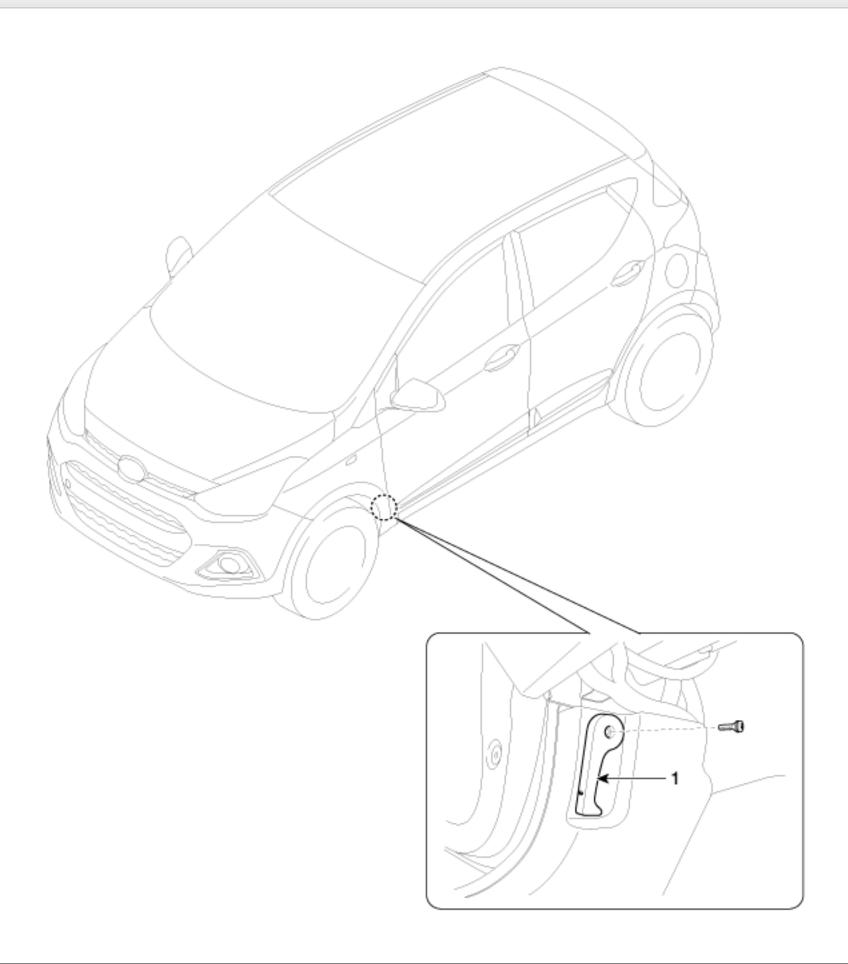
3. Disconnect the hood latch cable (A) and remove the hood latch (B).



4. Install in the reverse order of removal.

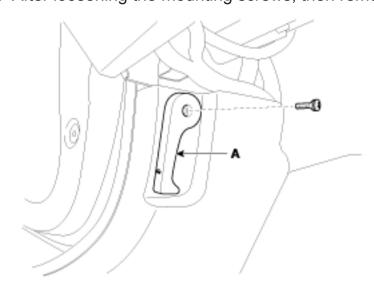
# i Information

- Make sure the hood latch release cable is connected properly.
- Make sure the hood locks/unlocks and opens/closes properly.
- · Adjust the latch alignment.



1. Hood latch release handle

1. After loosening the mounting screws, then remove the hood release handle (A).



2. Install in the reverse order of removal.

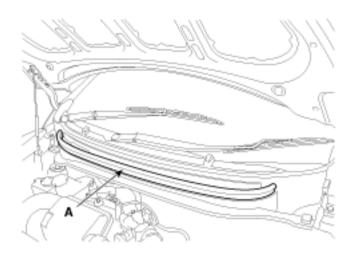


- Make sure the hood latch cable is connected properly.
- Make sure the hood locks/unlocks and opens/closes properly.

1. Remove the glue on end of both sides of the hood weatherstrip (A).

# NOTICE

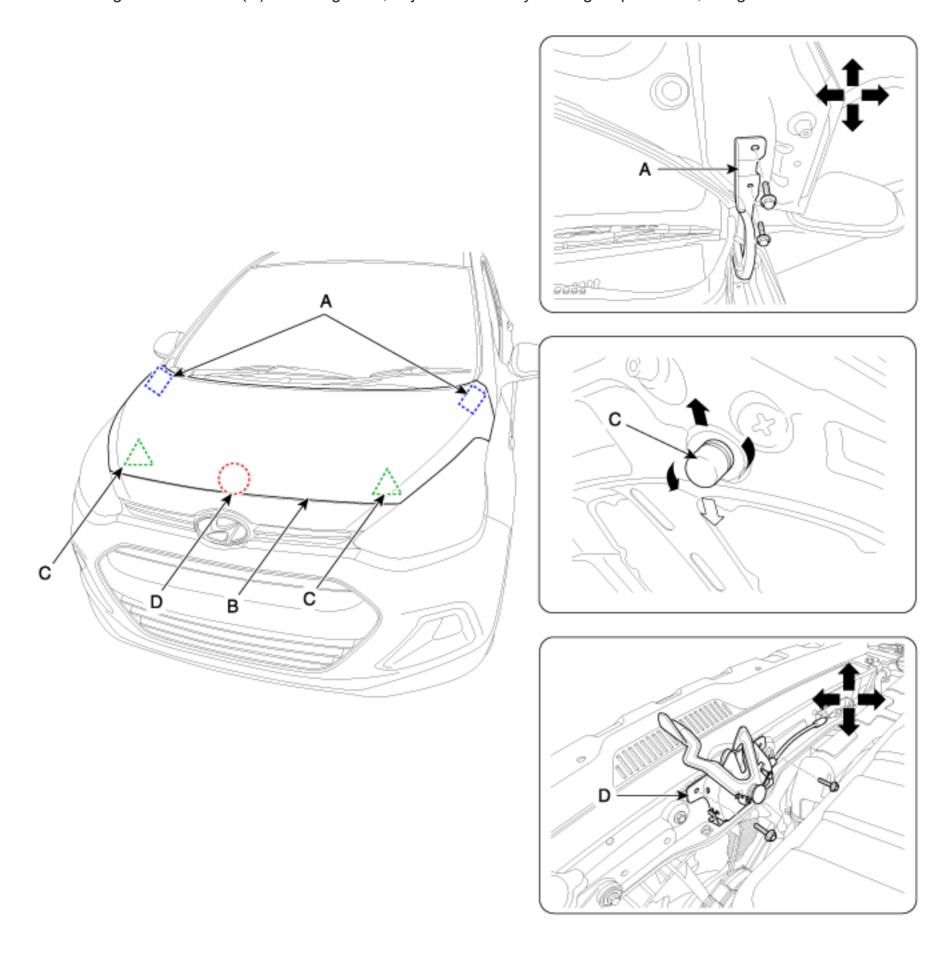
• Be careful not to scratch the hood weatherstrip.

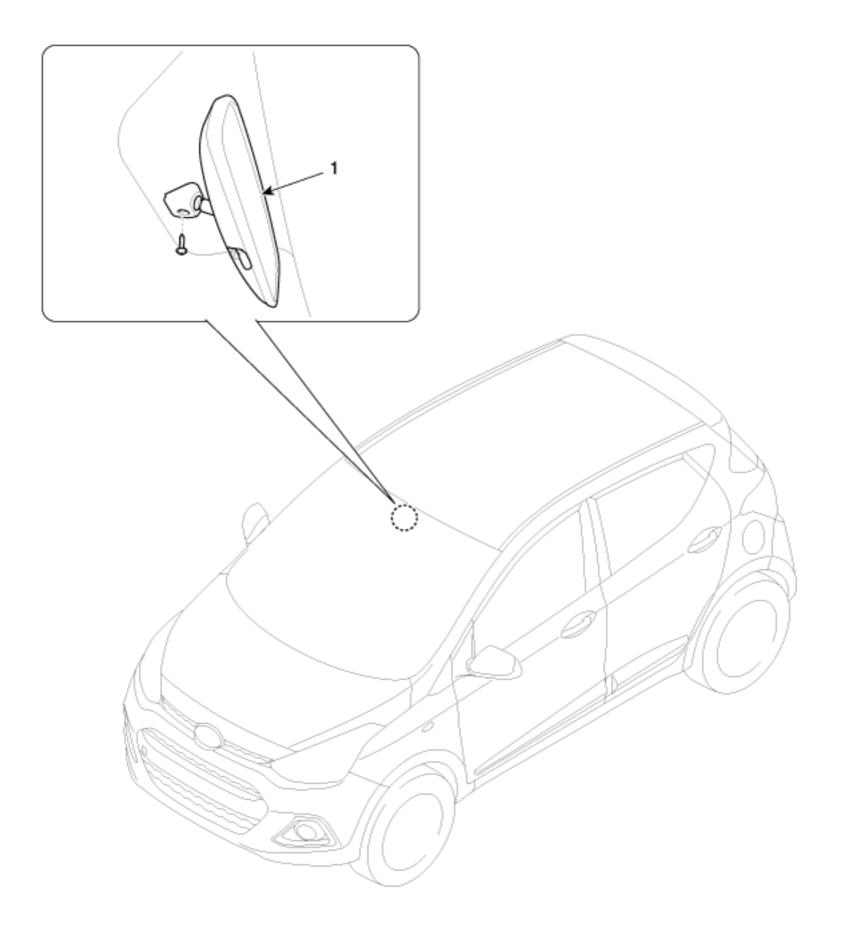


2. Install in the reverse order of removal.

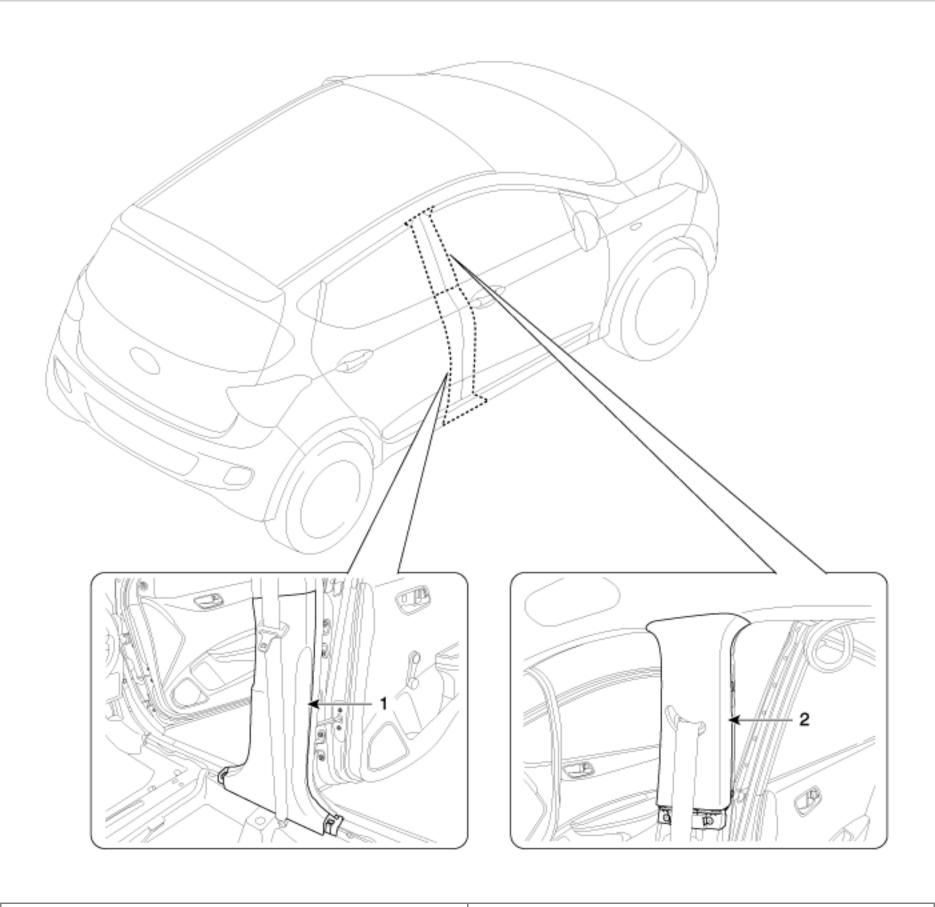
# **ADJUSTMENT**

- 1. After loosening the hinge (A) mounting bolt, adjust the hood (B) by moving it up or down, or right or left.
- 2. Adjust the hood height by turning the hood overslam bumpers (C).
- 3. After loosening the hood latch (D) mounting bolts, adjust the latch by moving it up or down, or right or left.





1. Inside rear view mirror



1. Center pillar lower trim

2. Center pillar upper trim

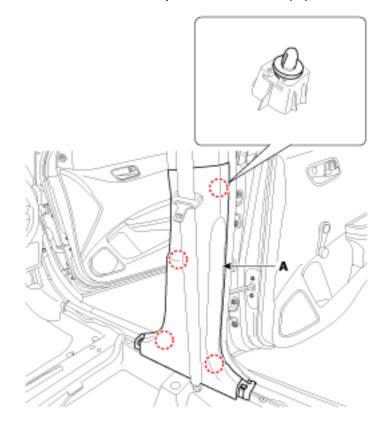
### [Center pillar lower trim]

# **▲** CAUTION

• Put on gloves to protect your hands.

### NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the front door scuff trim.
   (Refer to Interior Trim "Door Scuff Trim")
- Remove the rear door scuff trim. (Refer to Interior Trim - "Door Scuff Trim")
- 3. Slighty remove the front door body side weatherstrip.
- 4. Slighty remove the rear door body side weatherstrip.
- 5. Remove the center pillar lower trim (A).



6. Install in the reverse order of removal.

# information

Replace any damaged clips.

### [Center pillar upper trim]

# **▲** CAUTION

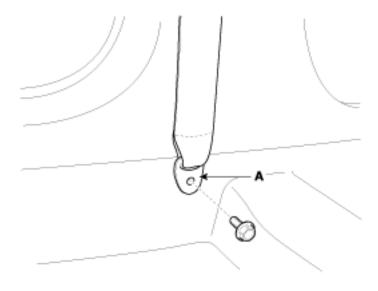
• Put on gloves to protect your hands.

### **NOTICE**

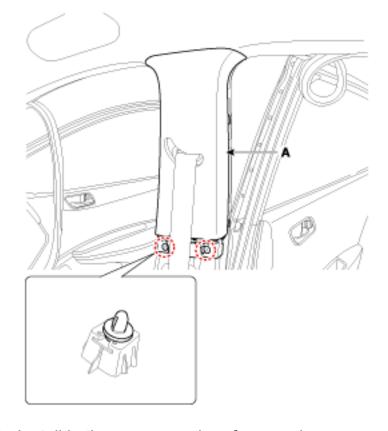
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. Remove the center pillar lower trim.
- 2. After loosening the mounting bolt, the remove the front seat belt lower anchor (A).

### Tightening torque:

39.2 ~ 53.9 N.m (4.0 ~ 5.5 kgf.m, 28.8 ~ 39.8 lb-ft)



3. Using a screwdriver or remover, remove the center pillar upper trim (A).

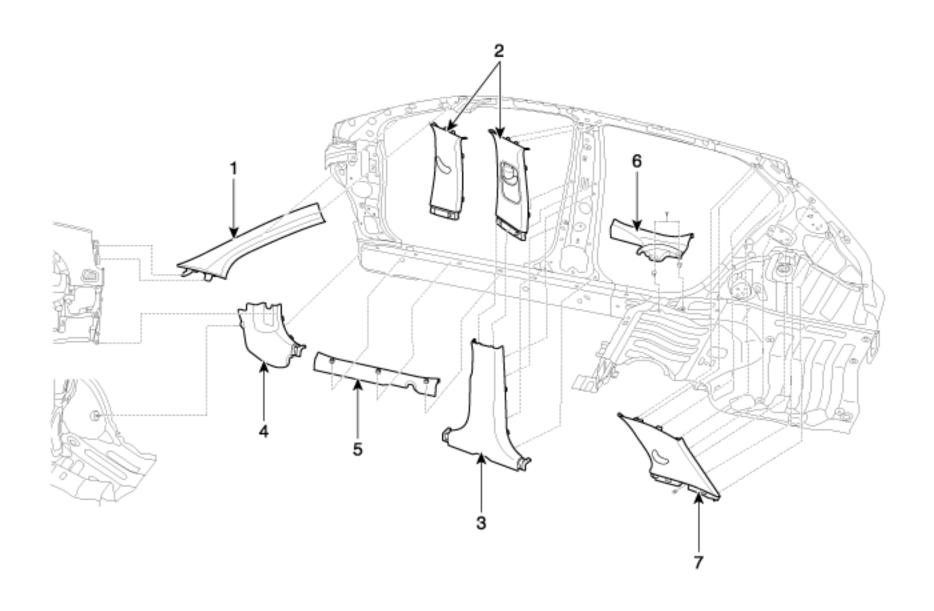


4. Install in the reverse order of removal.

# i Information

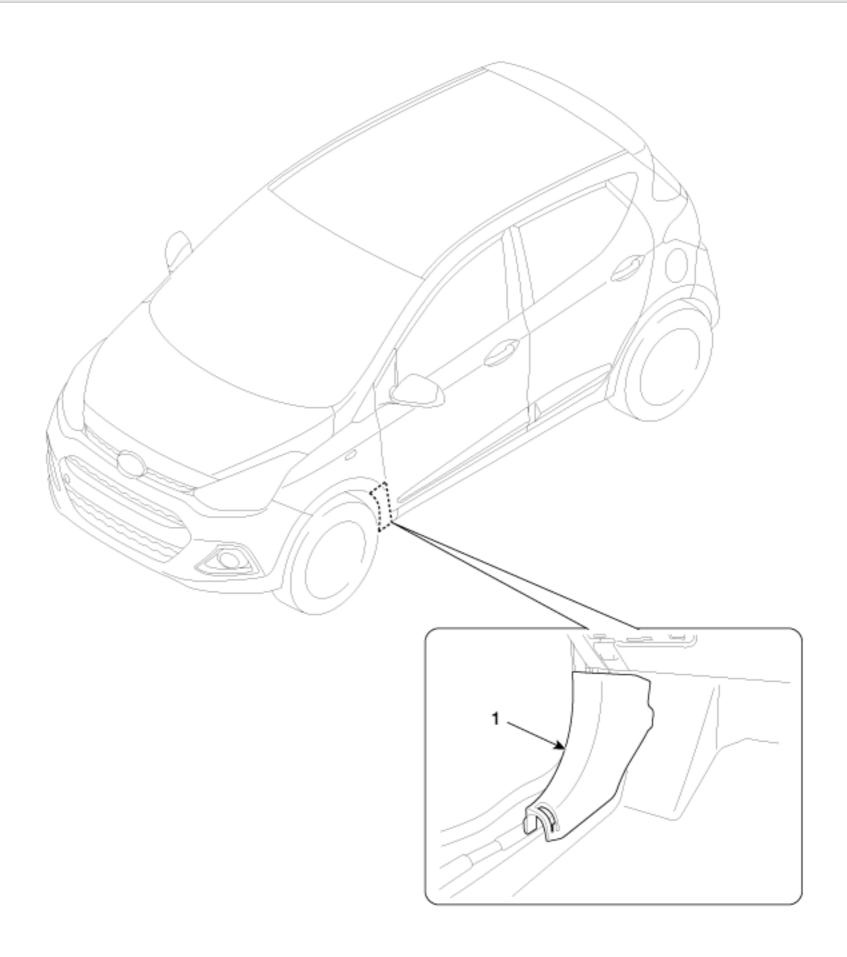
• Replace any damaged clips.

# **COMPONENTS**



- 1. Front pillar trim
- 2. Center pillar upper trim
- 3. Center pillar lower trim
- 4. Cowl side trim

- 5. Front door scuff trim
- 6. Rear door scuff trim
- 7. Rear pillar trim



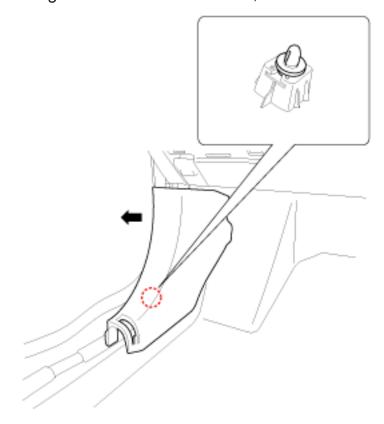
1. Cowl side trim

# **▲** CAUTION

• Put on gloves to protect your hands.

### NOTICE

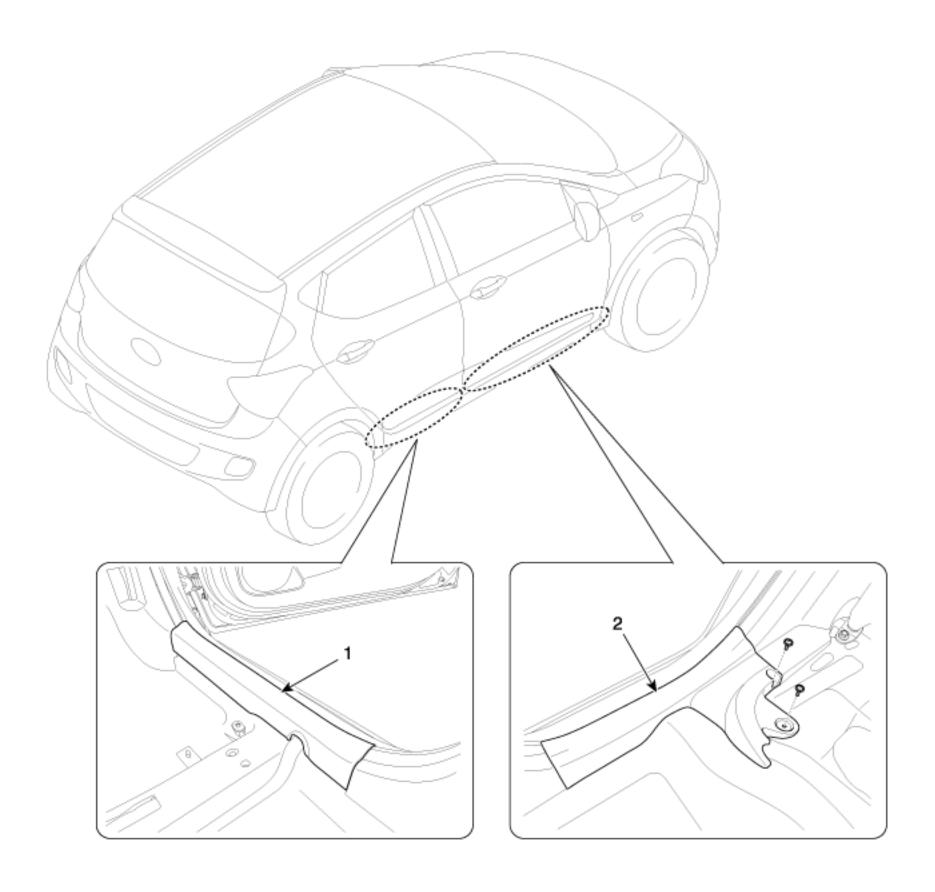
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the front door scuff trim.
   (Refer to Interior Trim "Door Scuff Trim")
- Remove the hood latch release handle.
   (Refer to Hood "Hood Latch Release Handle")
- 3. Slighty remove the front door body side weatherstrip.
- 4. Using a screwdriver or remover, remove the cowl side trim (A).



5. Install in the reverse order of removal.



Replace any damaged clips.



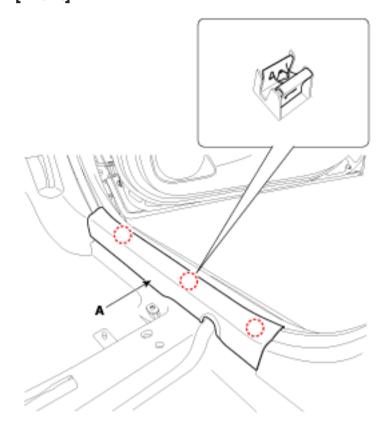
1. Front door scuff trim 2. Rear door scuff trim

# **▲** CAUTION

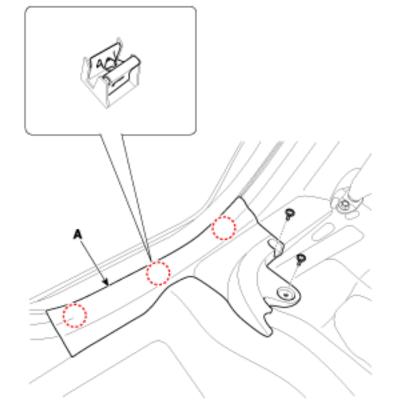
• Put on gloves to protect your hands.

# NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Using a screwdriver or remover, remove the front door scuff tirm (A).
   [Front]



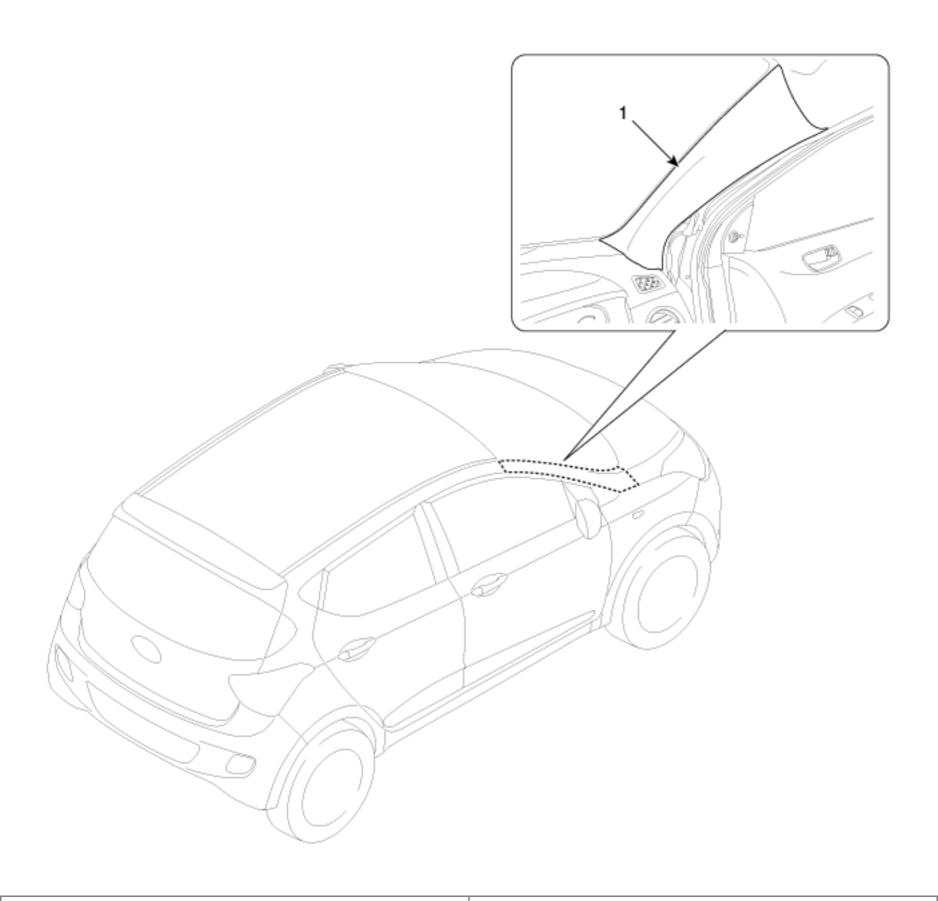
Using a screwdriver or remover, remove the rear door scuff tirm (A).[Rear]



3. Install in the reverse order of removal.



• Replace any damaged clips.



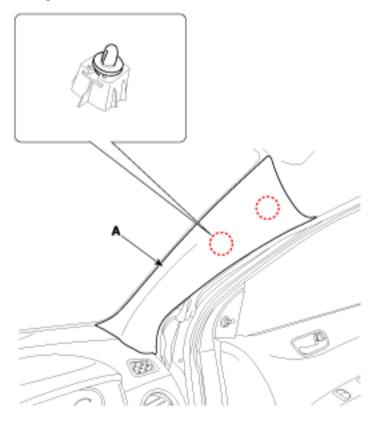
1. Front pillar trim

# **▲** CAUTION

• Put on gloves to protect your hands.

### NOTICE

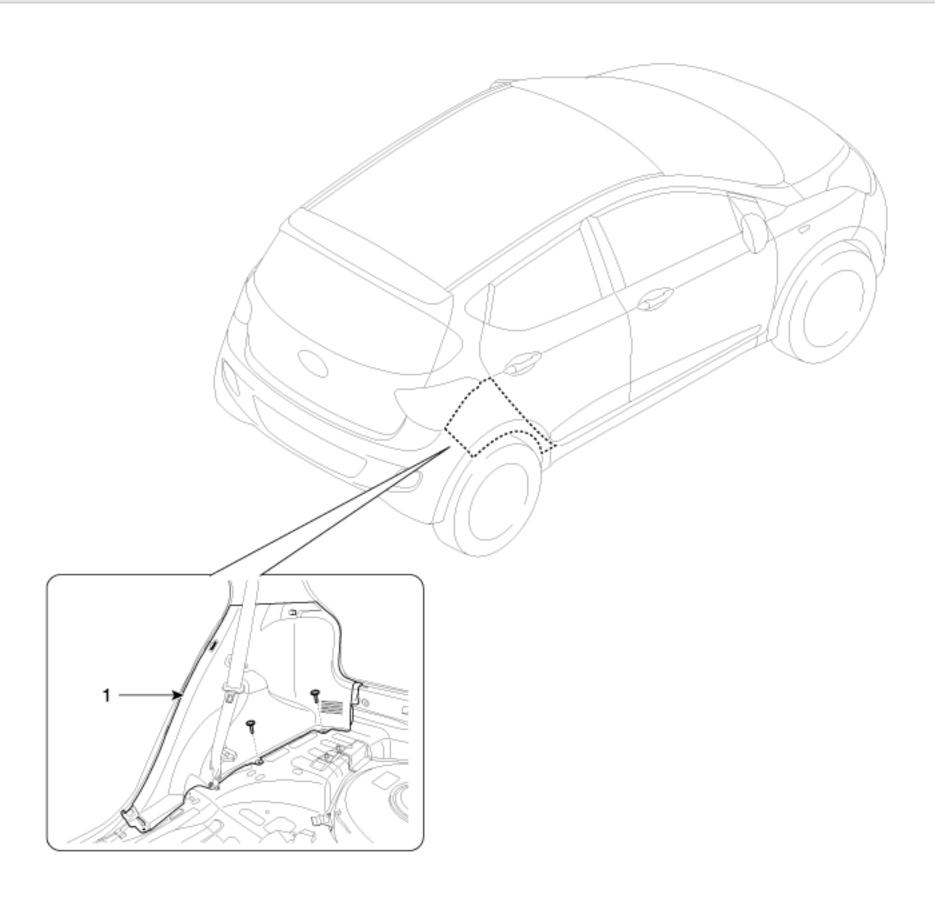
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. Slighty remove the front door body side weatherstrip.
- 2. Using a screwdriver or remover, remove the front pillar trim (A).



3. Install in the reverse order of removal.



· Replace any damaged clips.



1. Luggage side trim

# **A** CAUTION

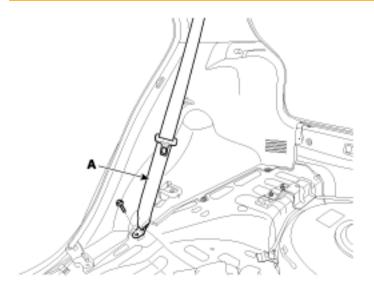
• Put on gloves to protect your hands.

### NOTICE

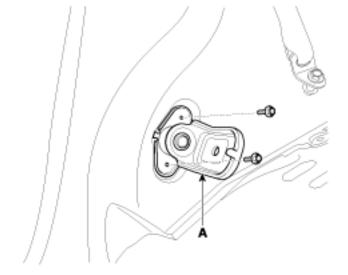
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the rear seat assembly.
   (Refer to Rear Seat "Rear Seat Assembly")
- Remove the rear door scuff trim. (Refer to Interior Trim - "Door Scuff Trim")
- Remove the rear transverse trim.
   (Refer to Interior Trim "Rear Transverse Trim")
- 4. Slighty remove the rear door body side weatherstrip.
- 5. Slighty remove the tail gate weatherstrip.
- 6. After loosening the mounting bolt, then remove the rear seat belt lower anchor (A).

### Tightening torque:

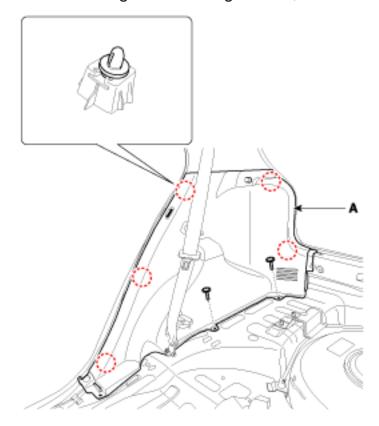
39.2 ~ 53.9 N.m (4.0 ~ 5.5 kgf.m, 28.8 ~ 39.8 lb-ft)



7. After loosening the mounting bolts, then remove the rear seat folding bracket (A).



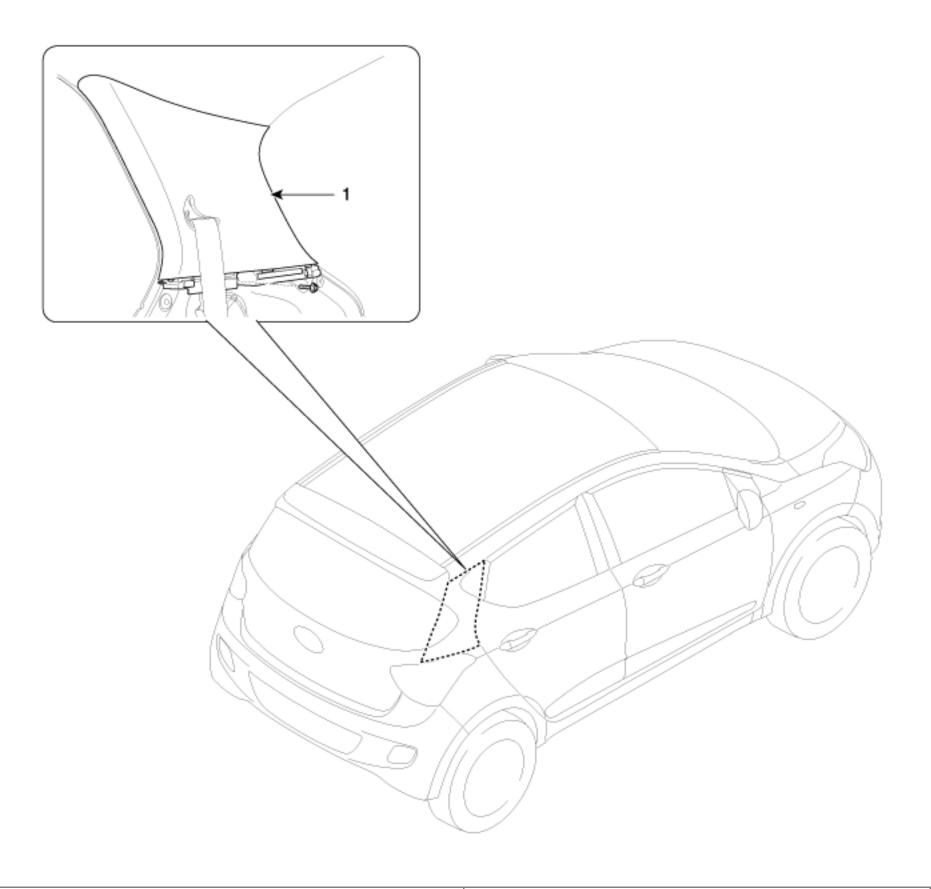
8. After loosening the mounting screws, then remove the luggage side trim (A).



9. Install in the reverse order of removal.

## i Information

- Make sure the connector are connected in properly.
- Replace any damaged clips.



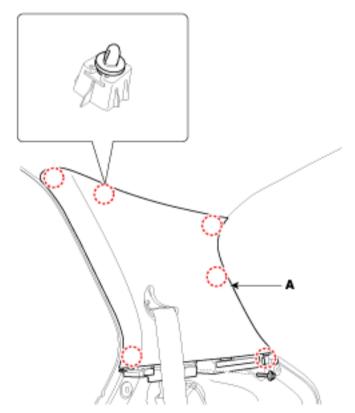
1. Rear pillar trim

## **▲** CAUTION

• Put on gloves to protect your hands.

### NOTICE

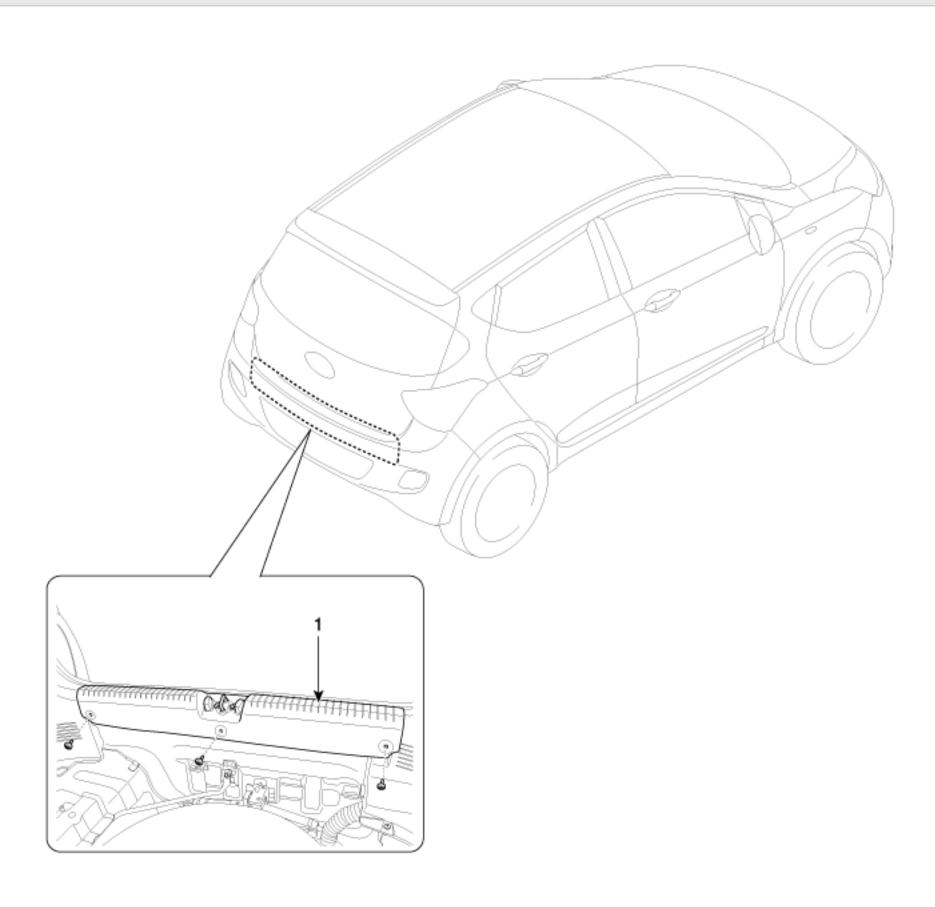
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the luggage side trim.
   (Refer to Interior Trim "Luggage Side Trim")
- 2. After loosening the mounting bolts, then remove the rear pillar trim (A).



3. Install in the reverse order of removal.



• Replace any damaged clips.



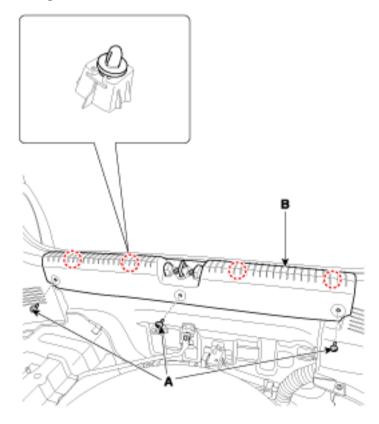
1. Rear transverse trim

## **▲** CAUTION

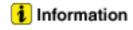
• Put on gloves to protect your hands.

### NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. Using a clip remover, detach the rear transverse trim mounting clips (A).
- 2. Using a screwdriver or remover, remove the rear transverse trim (B).



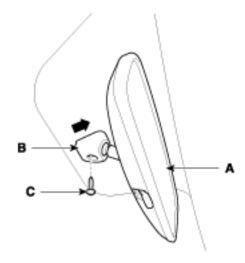
3. Install in the reverse order of removal.



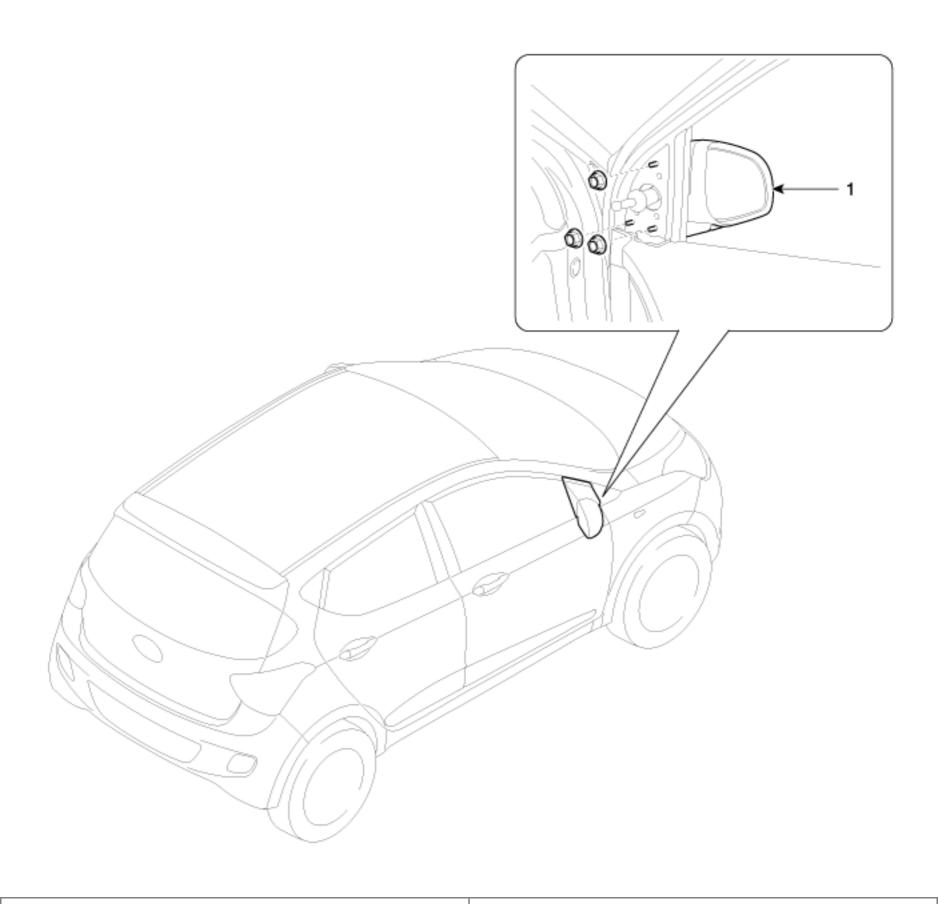
Replace any damaged clips.

## **▲** CAUTION

- Put on gloves to protect your hands.
- 1. Loosen the inside rear view mirror mounting screw (C).
- 2. Push the inside rear view mirror base (B) up to remove the inside rear view mirror assembly (A).



3. Install in the reverse order of removal.



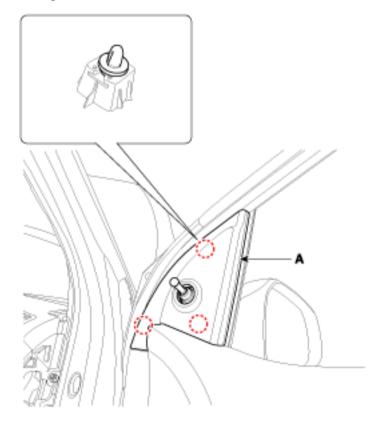
1. Outside rear view mirror

### **▲** CAUTION

• Put on gloves to protect your hands.

### NOTICE

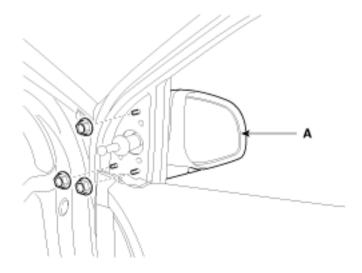
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Take care not to scratch the body surface.
- 1. Using a screwdriver or remover, remove the front door quadrant inner cover (A).



2. After loosening the mounting bolts, then remove the outside rear view mirror (A).

#### **Tightening torque:**

 $6.9 \sim 10.8 \text{ N.m} (0.7 \sim 1.1 \text{ kgf.m}, 5.1 \sim 8.0 \text{ lb-ft})$ 

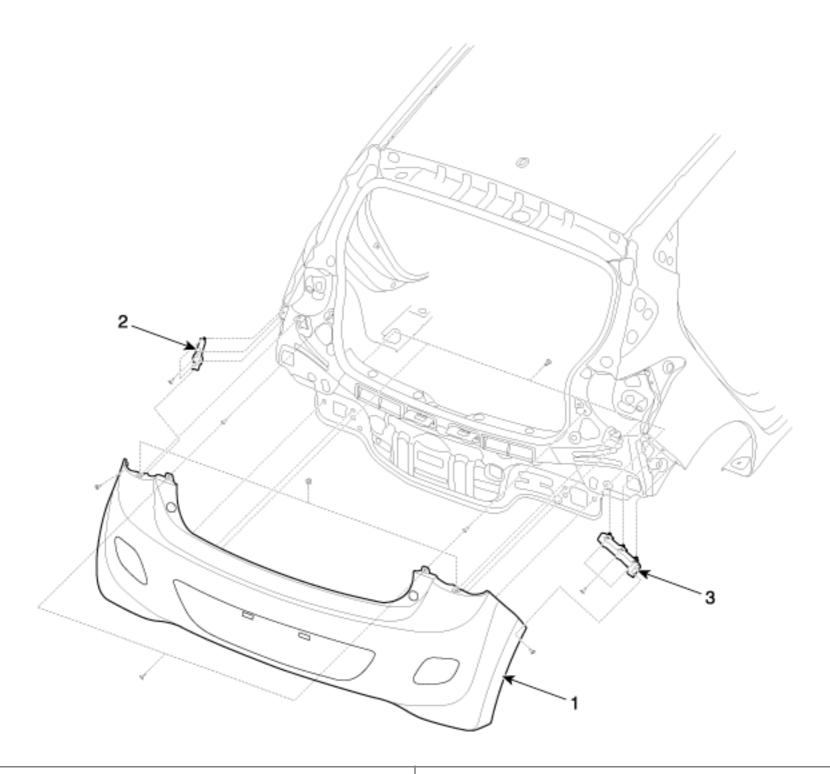


3. Install in the reverse order of removal.

## i Information

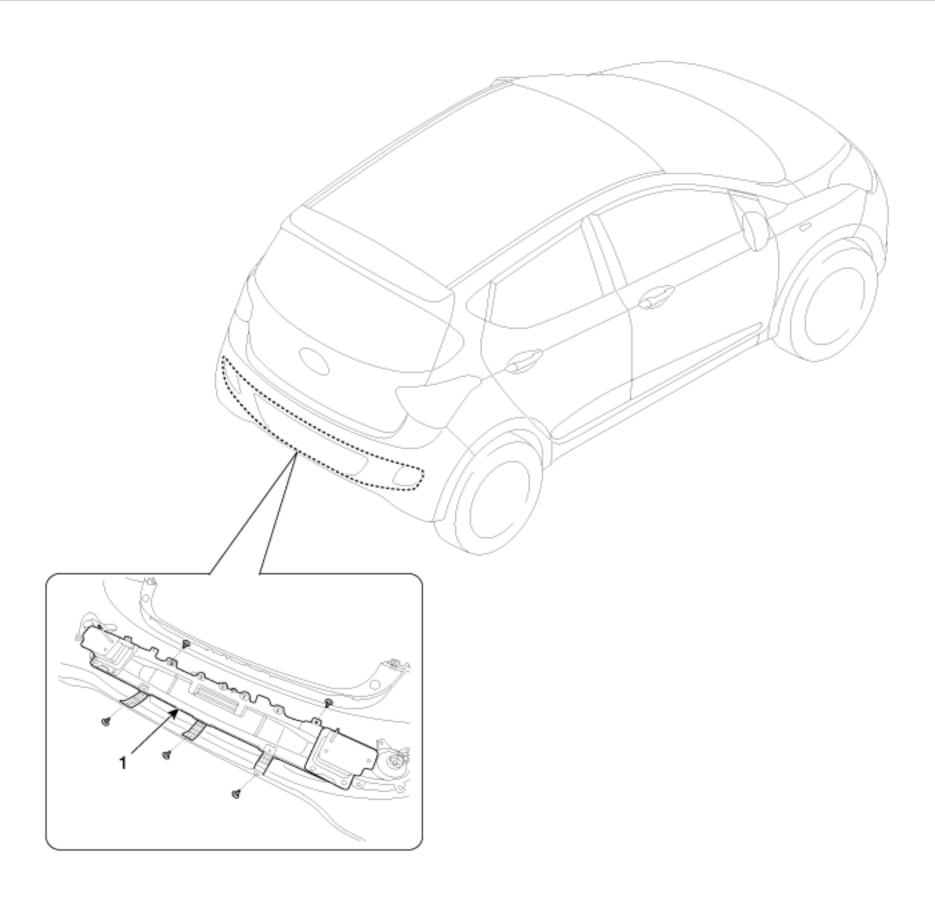
- Make sure the connector is connected properly.
- Replace any damaged clips.

## **COMPONENTS**



- 1. Rear bumper cover
- 2. Rear bumper side bracket [LH]

3. Rear bumper side bracket [RH]



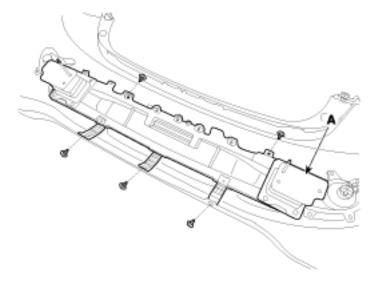
1. Rear bumper beam assembly

## **▲** CAUTION

• Put on gloves to protect your hands.

### NOTICE

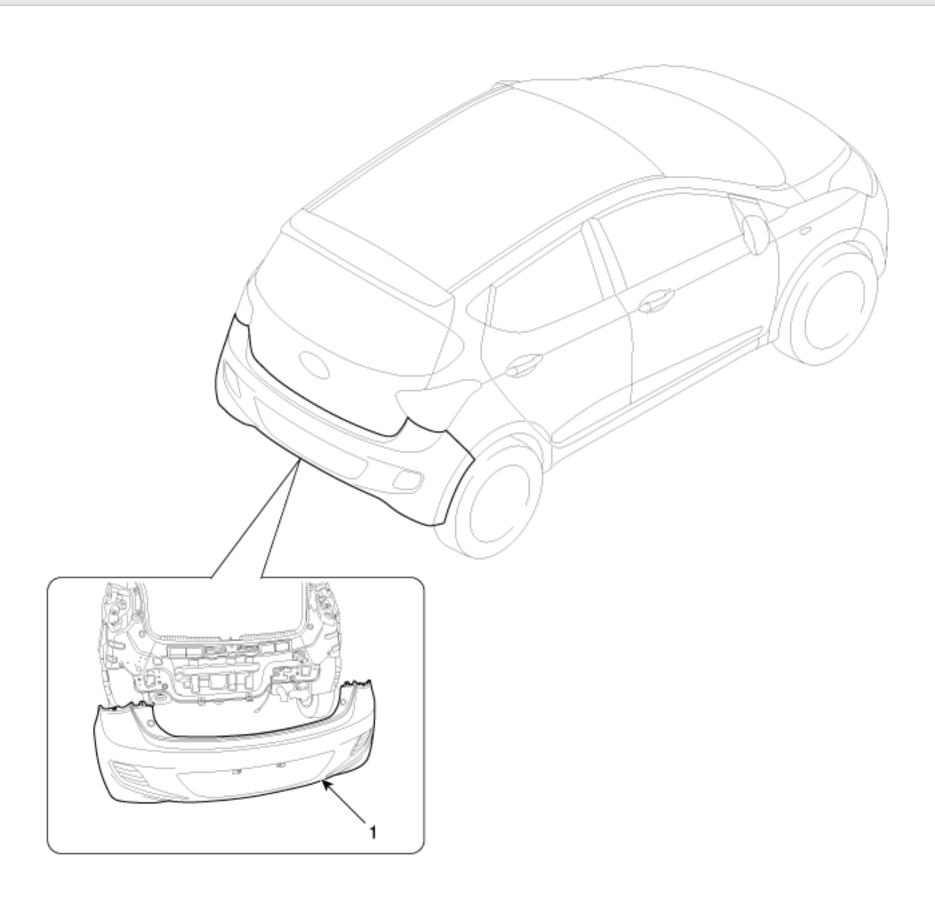
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the rear bumper cover.
   (Refer to Rear Bumper "Rear Bumper Cover")
- 2. After loosening the mounting screws and clips, then remove the rear bumper beam assembly (A).



3. Install in the reverse order of removal.

## information

Replace any damaged clips.



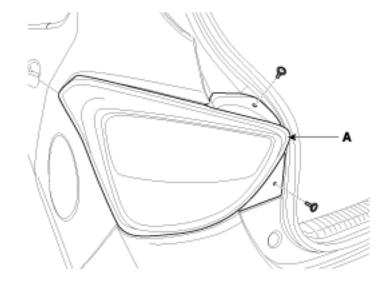
1. Rear Bumper Cover

## **▲** CAUTION

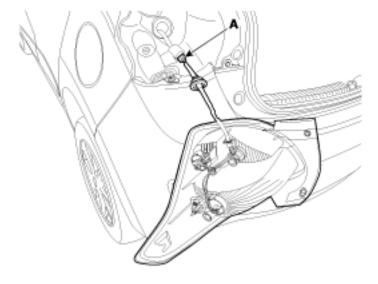
• Put on gloves to protect your hands.

### NOTICE

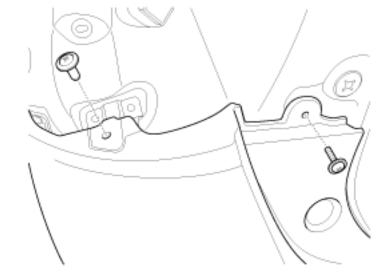
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. After loosening the mounting screws, then remove the rear combination lamp (A).



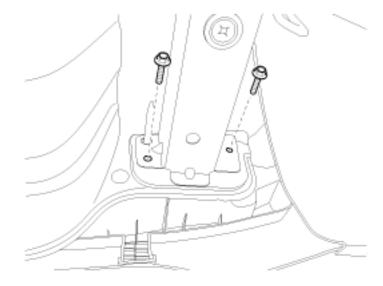
2. Disconnect the rear combination lamp connector (A).



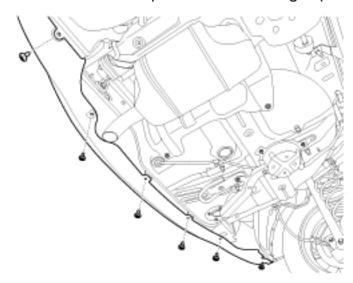
3. Loosen the rear bumper upper mounting screw and clip.



4. Loosen the mounting bolts.



5. Loosen the rear bumper lower mounting clips.



6. After loosening the rear bumper side's mounting screws, then disconnect the side's.

# i Information

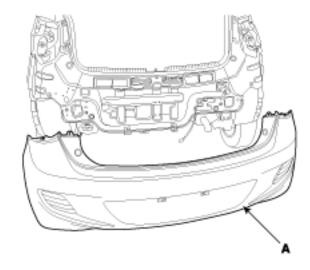
• Remove the rear bumper by pulling up the side of the rear bumper and then pull it out.

## **▲** CAUTION

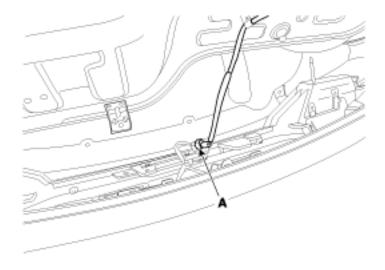
• When you pull out the front bumper, the side part of the rear bumper could be damaged by the projection.



7. Remove the rear bumper cover (A).



8. Disconnect the rear bumper main connector (A).

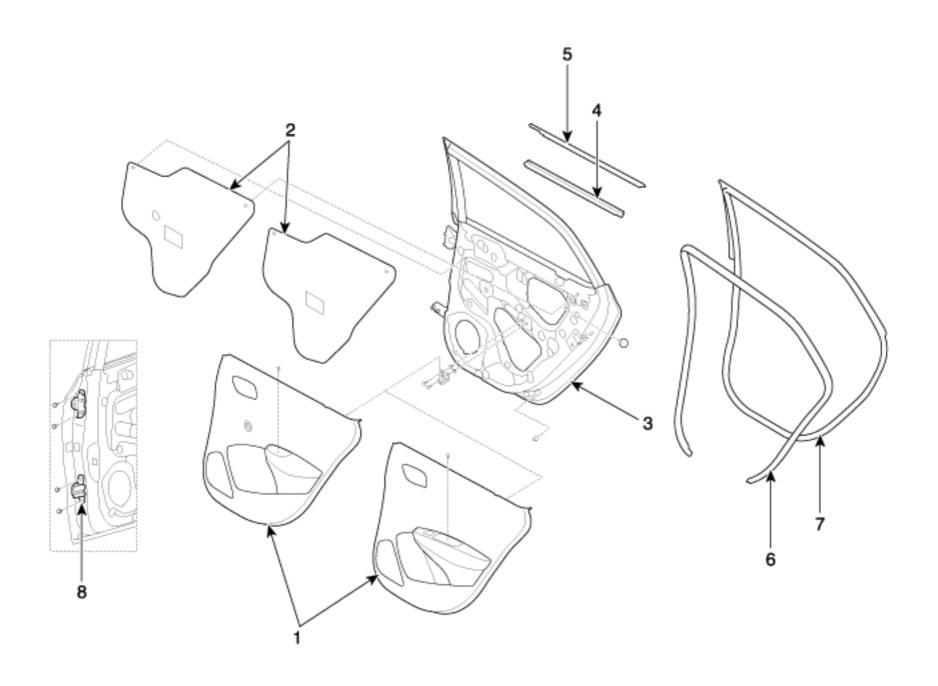


9. Install in the reverse order of removal.

## i Information

- Make sure the connector is plugged in properly.
- Replace any damaged clips.

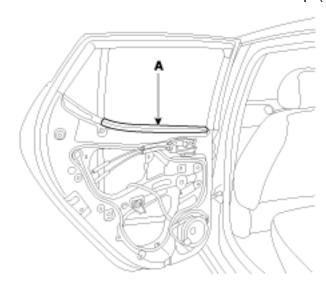
### **COMPONENTS**



- 1. Rear door trim
- 2. Rear door trim seal
- 3. Rear door panel
- 4. Rear door belt inside weatherstrip

- 5. Rear door belt outside weatherstrip
- 6. Front door body side weatherstrip
- 7. Front door side weatherstrip
- 8. Front door hinge

- Remove the rear door trim.
   (Refer to Rear Door "Rear Door Trim")
- 2. Remove the rear door belt inside weatherstrip (A).

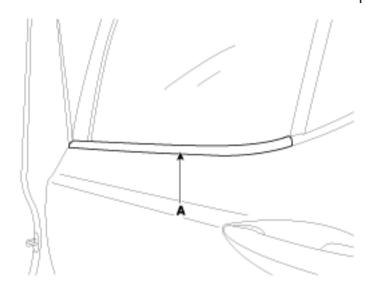


3. Install in the reverse order of removal.



• Replace any damaged clips.

- 1. Pull down rear door window glass by pressing the power window glass switch.
- 2. Remove the rear door belt outside weatherstrip (A).

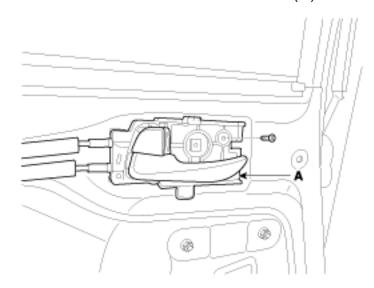


3. Install in the reverse order of removal.

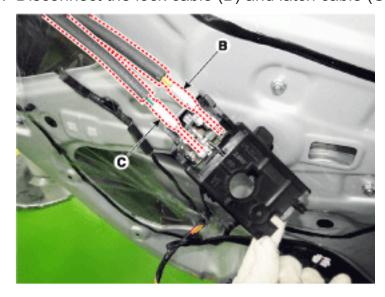


• Replace any damaged clips.

- Remove the rear door trim.
   (Refer to Rear Door "Rear Door Trim")
- 2. Remove the rear door inside handle (A).



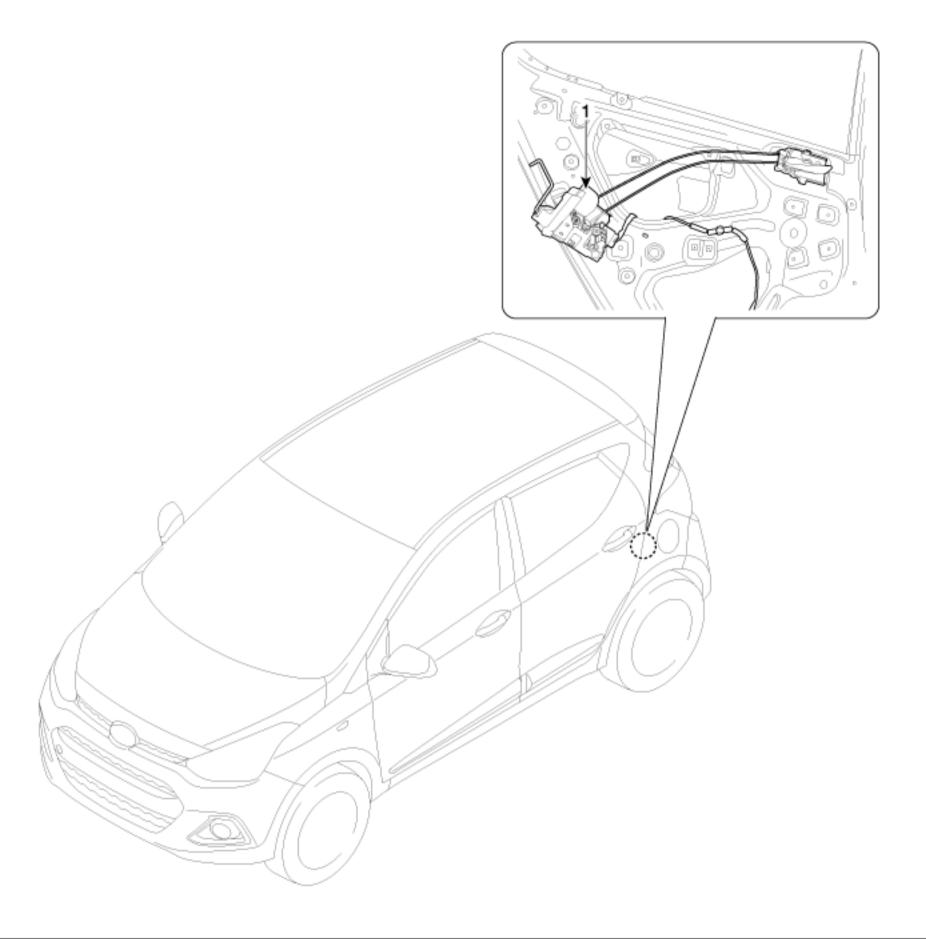
3. Disconnect the lock cable (B) and latch cable (C).



4. Install in the reverse order of removal.

## i Information

- Make sure the door locks/unlocks and opens/closes properly.
- Replace any damaged clips.

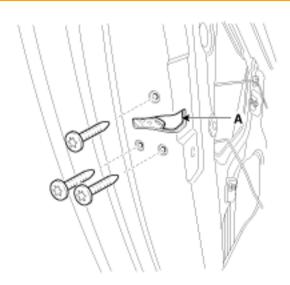


1. Rear door latch

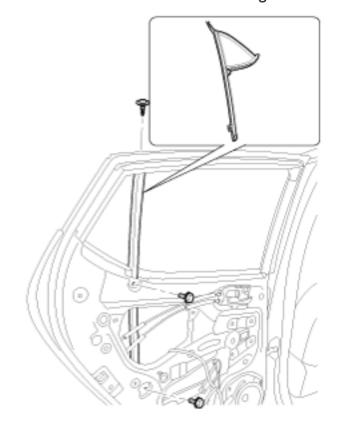
- Remove the rear door window glass.
   (Refer to Rear Door "Rear Door Window Glass")
- 2. Loosen the rear door latch (A) mounting screws.

#### **Tightening torque:**

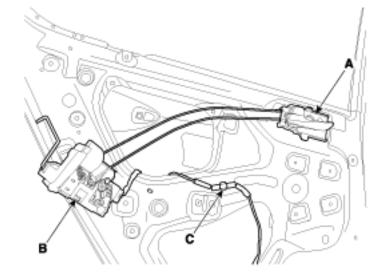
 $7.8 \sim 10.8 \text{ N.m} (0.8 \sim 1.1 \text{ kgf.m}, 5.8 \sim 8.0 \text{ lb-ft})$ 



3. Loosen the rear door channel mounting screw and bolts.



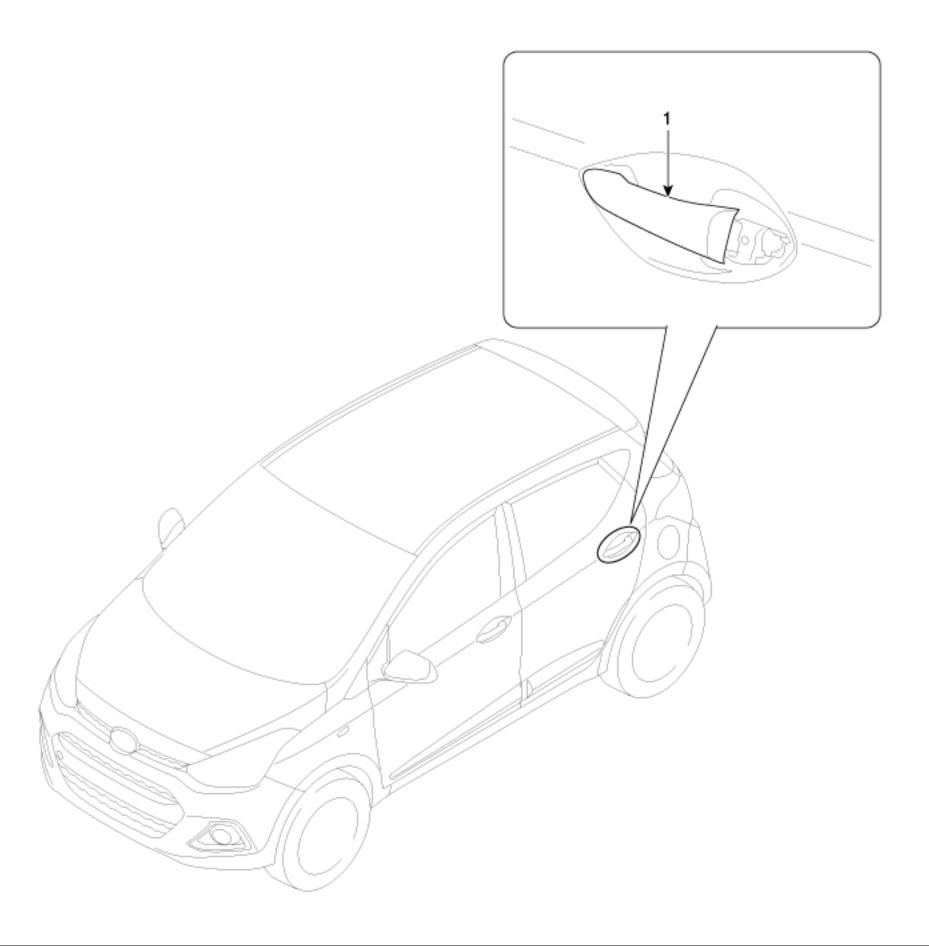
- 4. Remove the rear door inside handle (A).
- 5. Remove the rear door latch assembly (B)
- 6. Disconnect the rear door latch connector (C).



7. Install in the reverse order of removal.

## 1 Information

- Make sure the connector is connected properly.
- Make sure the door locks/unlocks and opens/closes properly.
- Replace any damaged clips.

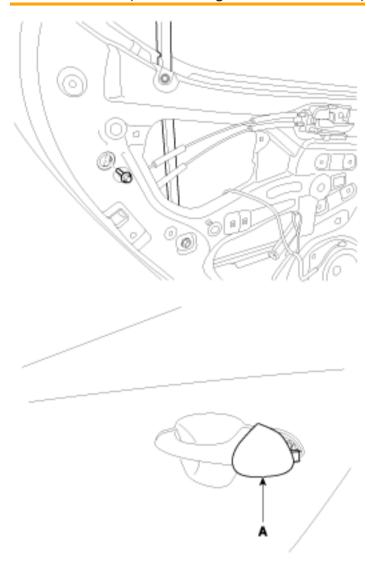


1. Rear door outside handle

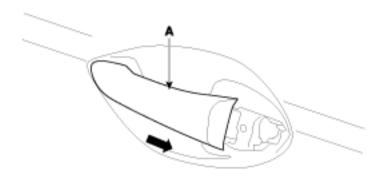
- 1. Remove the hole sticker.
- 2. After loosening the mounting bolt, then remove the rear door outside handle cover (A).

#### **Tightening torque:**

 $7.8 \sim 11.8 \text{ N.m} (0.8 \sim 1.2 \text{ kgf.m}, 5.8 \sim 8.7 \text{ lb-ft})$ 



3. Remove the rear door outside handle (A) by sliding it rearward.



4. Install in the reverse order of removal.

### 🚺 Information

• Make sure the door locks/unlocks and opens/closes properly.

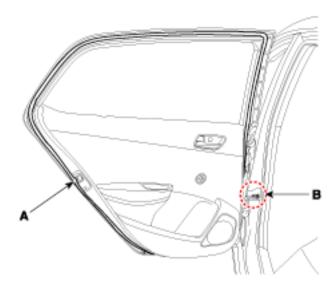


1. Loosen the rear door checker (B) mounting bolt.

#### **Tightening torque:**

19.6 ~ 29.4 N.m (2.0 ~ 3.0 kgf.m,14.5 ~ 21.7 lb-ft)

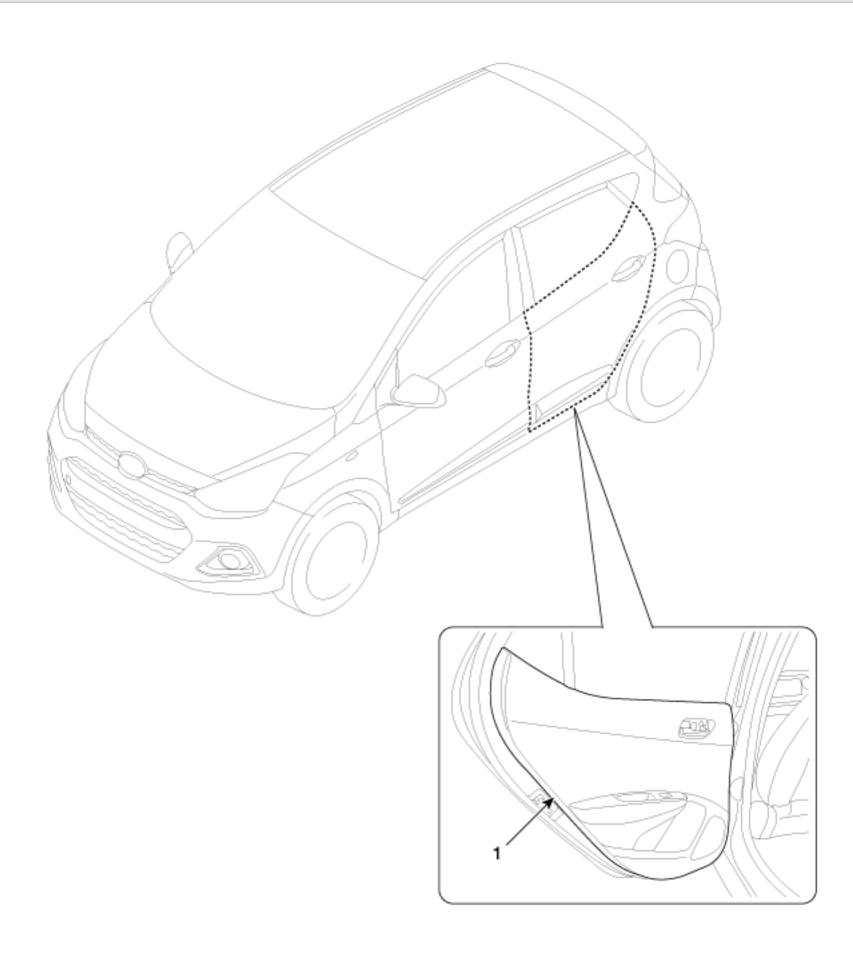
2. Detach the clips, then remove the rear door side weatherstrip (A).



3. Install in the reverse order of removal.



• Replace any damaged clips.



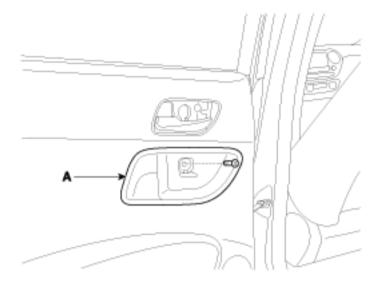
1. Rear door trim

### **▲** CAUTION

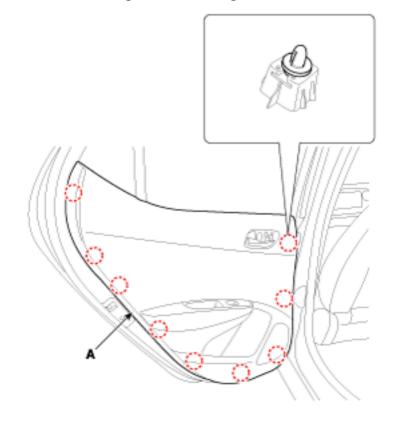
• Put on gloves to protect your hands.

### NOTICE

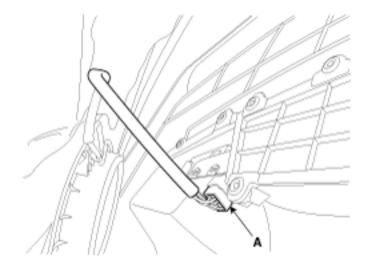
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Be careful not to scratch the door trim and other parts.
- 1. After loosening the mounting screw, then remove the rear door inside handle cover (A).



2. After loosening the mounting screw, then remove the rear door trim (A).



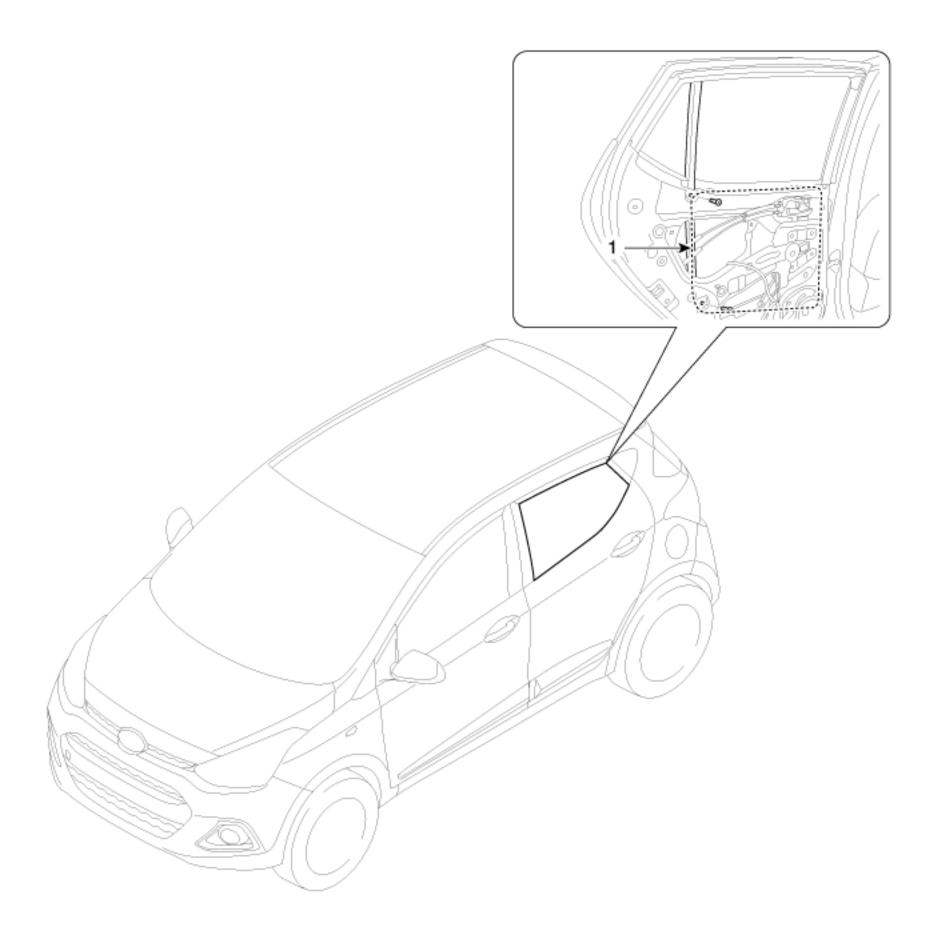
3. Disconnect the power window switch connector (A).



4. Install in the reverse order of removal.

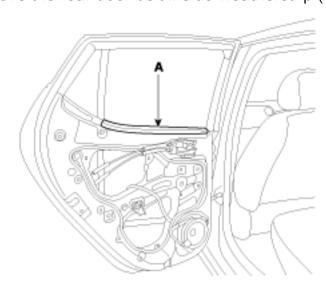
# 1 Information

- Make sure the door locks/unlocks and opens/closes properly.
- Replace any damaged clips.



1. Rear door window glass

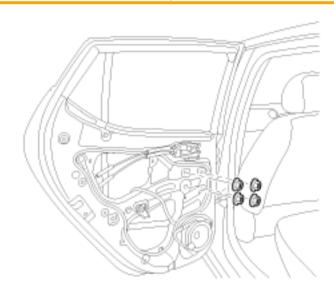
- Remove the rear door trim.
   (Refer to Rear Door "Rear Door Trim")
- 2. Remove the rear door belt inside weatherstrip (A).



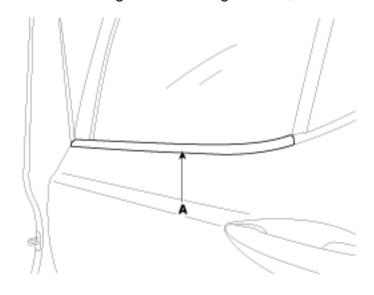
3. After releasing mounting nuts, pull out rear door window regulator as arrow direction.

#### **Tightening torque:**

 $3.9 \sim 5.9 \text{ N.m} (0.4 \sim 0.6 \text{ kgf.m}, 2.9 \sim 4.3 \text{ lb-ft})$ 



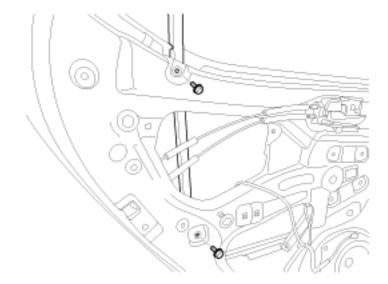
4. After loosening the mounting screws, then remove the rear door belt outside weatherstrip (A).



5. Loosen the rear door channel mounting bolts.

#### **Tightening torque:**

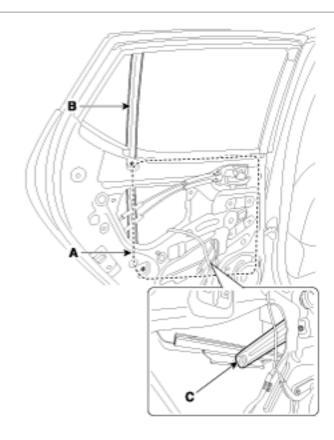
3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)



6. To remove glass (A), push and remove the glass mounting part (C) as arrow direction. And then remove the glass (A) carefully after pulling out it from channel (B).

### ▲ CAUTION

- Use the door switch to align the mounting hole/bolt with the hole in the door.
- If unable to operate the window motor, remove the motor and align the hole by hand.
- Be careful not to drop the glass and/or scratch the glass surface.



7. Install in the reverse order of removal.

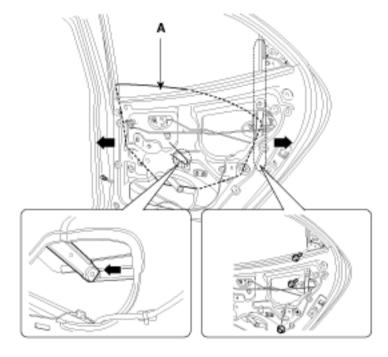
### i Information

- Roll the glass up and down to see if it moves freely without binding.
- Adjust glass position as needed.
- · Replace any damaged clips.

### **Glass Adjustment**

## i Information

- · Check the glass run channel for damage or deterioration, and replace them if necessary.
- Remove the rear door trim.
   (Refer to Rear Door "Rear Door Trim")
- 2. Loosen the bolts to adjust the glass from rear door window regulator. And then loosen the channel mounting bolts and nut after carefully adjusting the glass (A) from side to side.



3. Check that the glass moves smoothly.

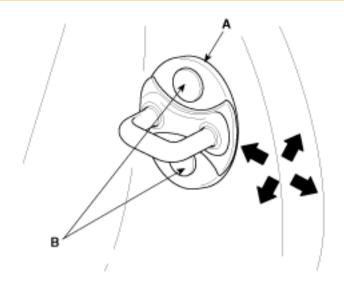
## Door Striker Adjustment

Make sure the door latches securely without slamming it. If necessary adjust the striker (A): The striker nuts are fixed. The striker can be adjusted up or down, and in or out.

1. Loosen the screws (B) just enough for the striker to move.

#### **Tightening torque:**

**(B)**: 8.8 ~ 13.7 N.m (0.9 ~ 1.4 kgf.m, 6.5 ~ 10.1 lb-ft)



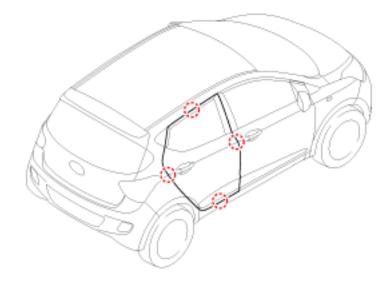
2. Tap on the striker with a plastic hammer to adjust the striker. The striker will not move much, but will give some adjustment.

3. Hold the outer handle out, and push the door against the body to be sure the striker allows a flush fit. If the door latches properly, tighten the screws and recheck.

#### **Door Position Adjustment**

#### NOTICE

- After installing the door, check for a flush fit with the Body, then check for equal gaps between the front, rear, and bottom, door edges and the body. Check that the door and body edges are parallel. before adjusting, replace the mounting bolts.
- 1. Check that the door and body edges are parallel.

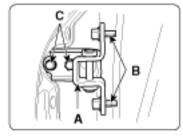


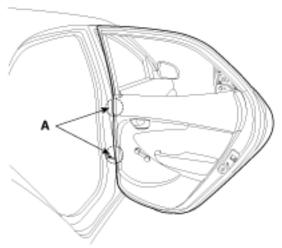
- 2. Place the vehicle on a firm, level surface when adjusting the doors.
- 3. Adjust at the hinges (A):
  - Loosen the door mounting bolts slightly, and move the door in or out until it aligns flush with the body.
  - Loosen the hinge mounting bolts slightly, and move the door backward or forward, up or down as necessary to equalize the gaps.
  - Place a shop towel on the jack to prevent damage to the door when adjusting the door.

#### **Tightening torque:**

**(B)**: 9.8 ~ 19.6 N.m (1.0 ~ 2.0 kgf.m, 7.2 ~ 14.5 lb-ft)

**(C)**: 37.3 ~ 41.2 N.m (3.8 ~ 4.2 kgf.m, 27.5 ~ 30.4 lb-ft)



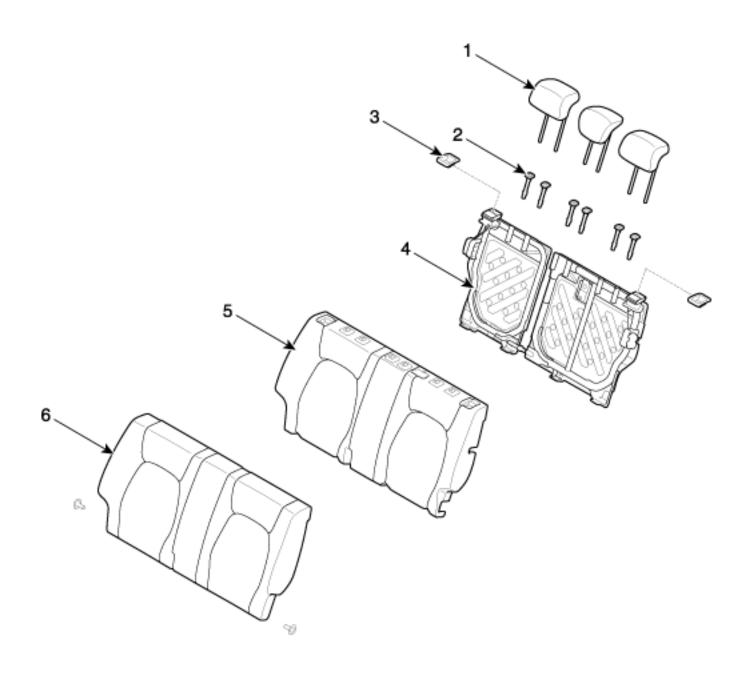


4. Grease the pivot portions of the hinges indicated.



# **COMPONENTS (1)**

## (Rear Seat Back Assembly)

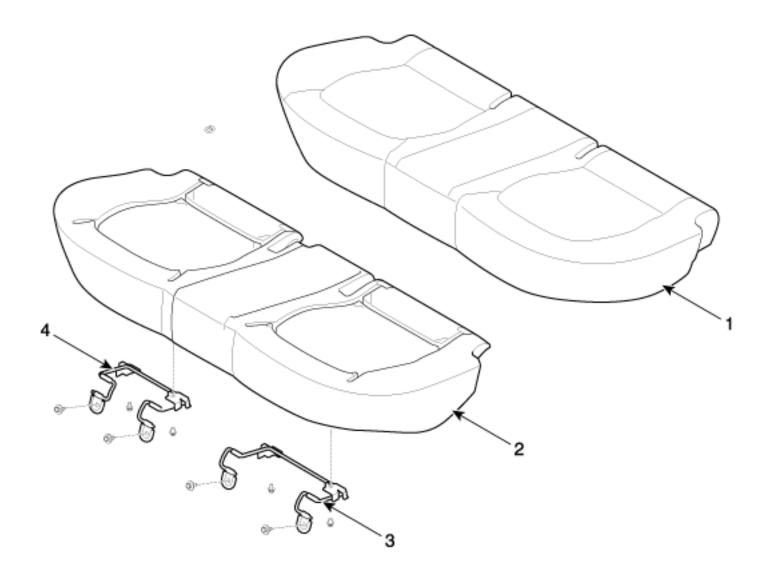


- 1. Rear seat headrest
- 2. Rear seat headrest guide
- 3. Rear seat back folding knob

- 4. Rear seat back frame assembly
- 5. Rear seat back pad
- 6. Rear seat back cover

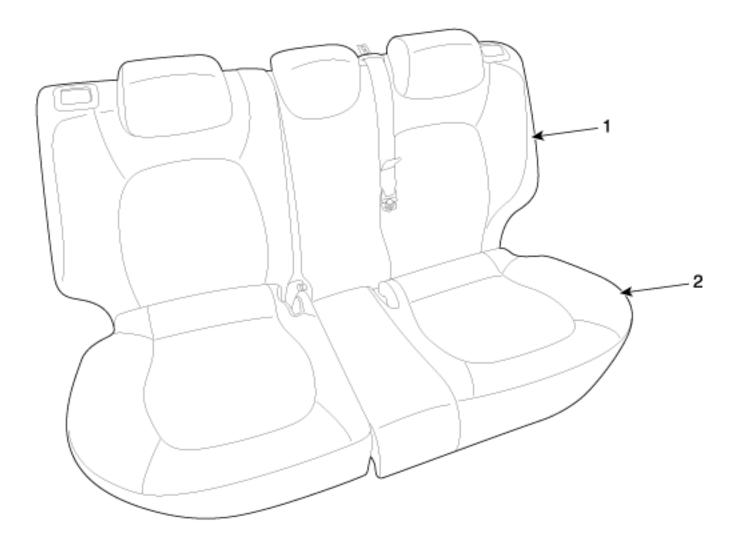
# **COMPONENTS (2)**

(Rear Seat Cushion Assembly)



- 1. Rear seat cushion cover
- 2. Rear seat cushion pad

- 3. Rear seat cushion tilt assembly [LH]
- 4. Rear seat cushion tilt assembly [RH]



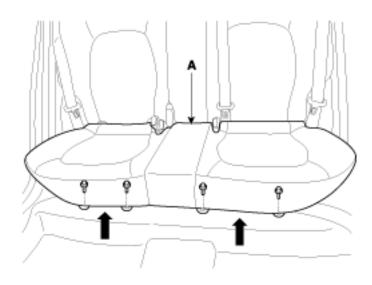
1. Rear seat back assembly

2. Rear seat cushion assembly

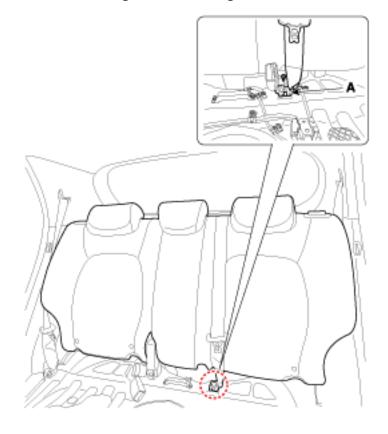
1. After loosening the mounting bolt, then remove the rear seat cushion (A).

### **Tightening torque:**

16.7 ~ 25.5 N.m (1.7 ~ 2.6 kgf.m, 12.3 ~ 18.8 lb-ft)



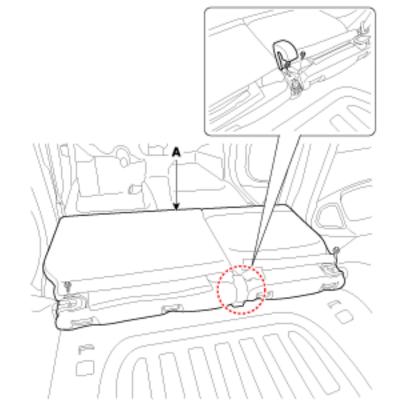
2. After loosening the mounting bolts, then remove the rear center third row anchor (A).



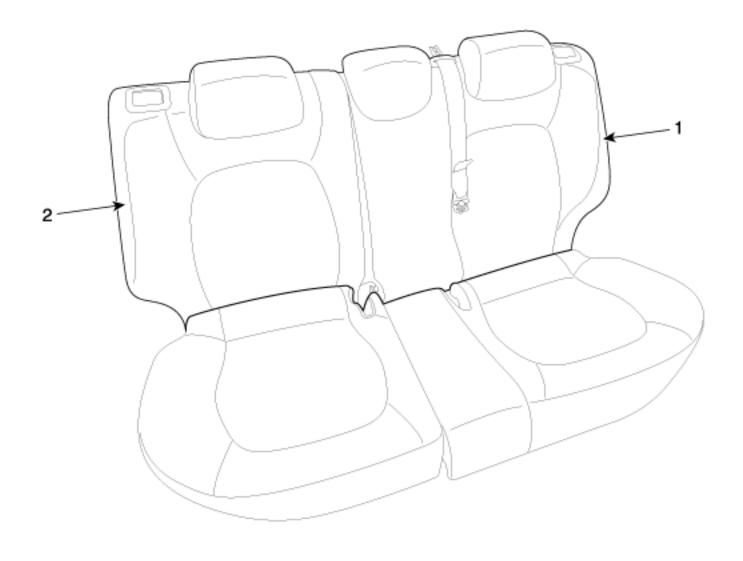
3. After loosening the mounting bolts, then remove the rear seat back (A).

### **Tightening torque:**

19.6 ~ 29.4 N.m (2.0 ~ 3.0 kgf.m, 14.5 ~ 21.7 lb-ft)



4. Install in the reverse order of removal.



1. Rear seat back cover [LH]

2. Rear seat back cover [RH]

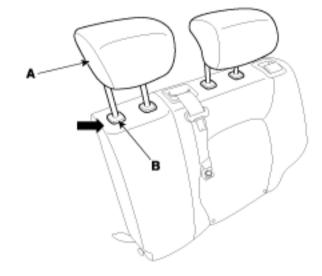
### [LH]

# **▲** CAUTION

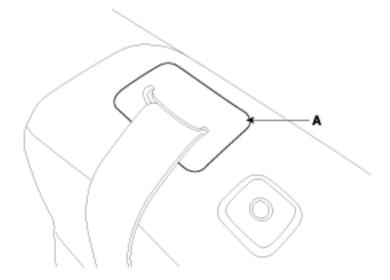
Put on gloves to protect your hands.

## NOTICE

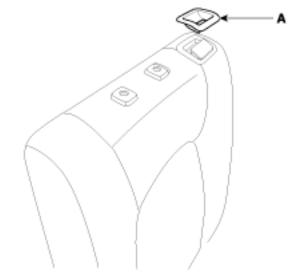
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the rear seat back assembly.
   (Refer to Rear Seat "Rear Seat Assembly")
- 2. Push the lock pin (B), remove the rear seat headrest (A).



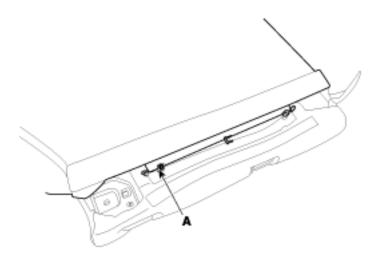
3. Using a screwdriver or remover, remove the rear center seat belt upper anchor cover (A).



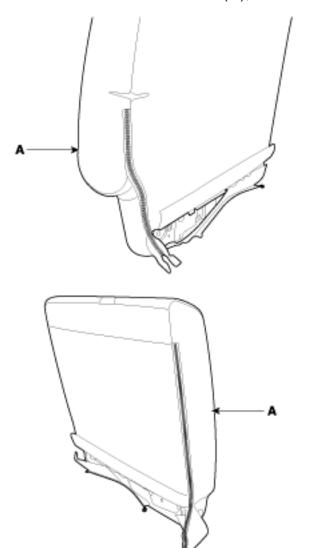
4. Using a screwdriver or remover, remove the rear seat folding cover (A).



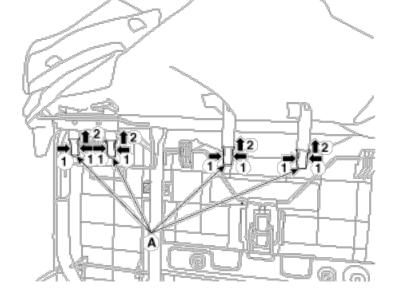
5. Remove the hog-ring clips (A) located in the rear lower side of rear seat back cover.



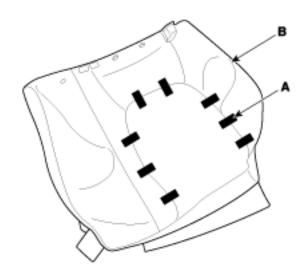
6. Zip off the front seat back cover (A), and then pull it up.



7. Turn the rear seat back cover inside out. Then pull out the headrest guides (A) while pinching both sides of the lower part of the guides, and remove them.



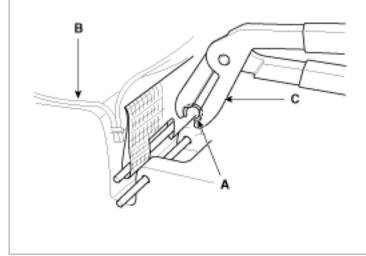
8. After removing the velcro tape and hog-ring clips (A) on the rear of seat back and remove the rear seat back cover (B).



9. Install in the reverse order of removal.

## information

- To prevent wrinkles, make sure the material is stretched evenly over the cover (B) before securing the hog-ring clips (A).
- Replace the hog-ring clips with new ones using special tool (C) (09880-4F000).



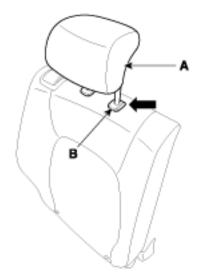
### [RH]

# **▲** CAUTION

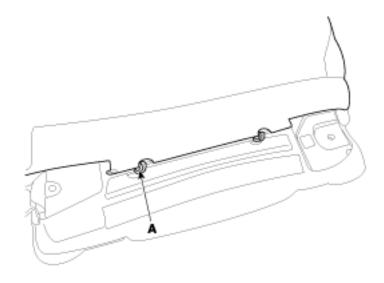
• Put on gloves to protect your hands.

### NOTICE

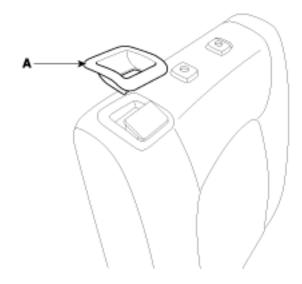
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the rear seat back assembly.
   (Refer to Rear Seat "Rear Seat Assembly")
- 2. Push the lock pin (B), remove the rear seat headrest (A).



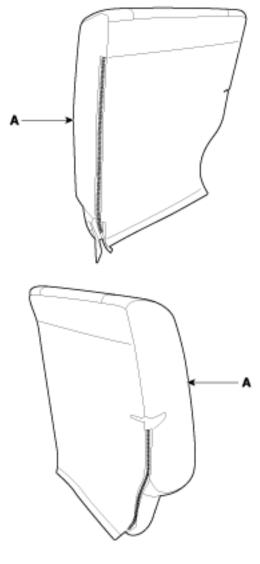
3. Remove the hog-ring clips (A) located in the rear lower side of rear seat back cover.



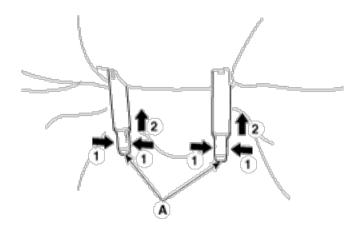
4. Using a screwdriver or remover, remove the rear seat folding cover (A).



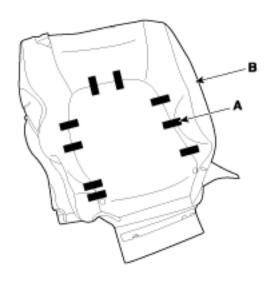
5. Zip off the front seat back cover (A), and then pull it up.



6. Turn the rear seat back cover inside out. Then pull out the headrest guides (A) while pinching both sides of the lower part of the guides, and remove them.



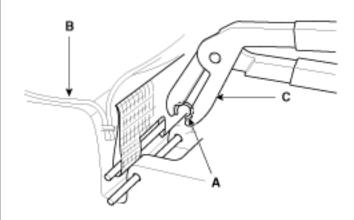
7. After removing the velcro tape and hog-ring clips (A) on the rear of seat back and remove the rear seat back cover (B).

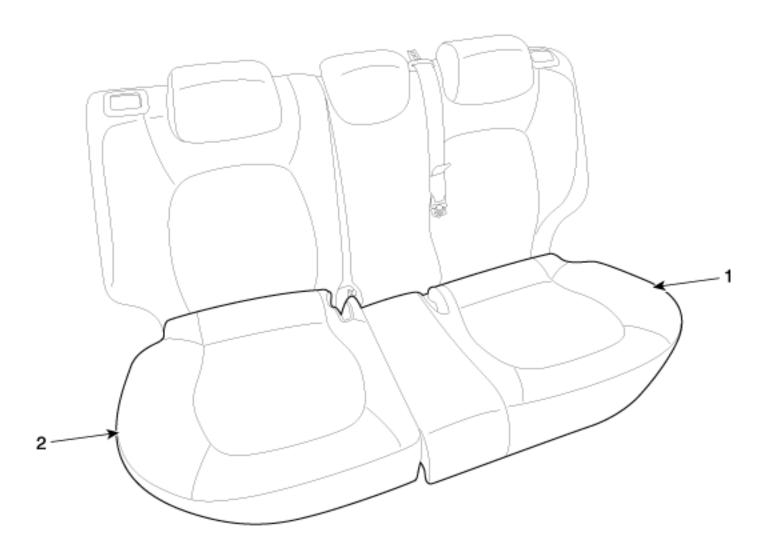


8. Install in the reverse order of removal.

# i Information

- To prevent wrinkles, make sure the material is stretched evenly over the cover (B) before securing the hog-ring clips (A).
- Replace the hog-ring clips with new ones using special tool (C) (09880-4F000).





1. Rear seat cushion cover

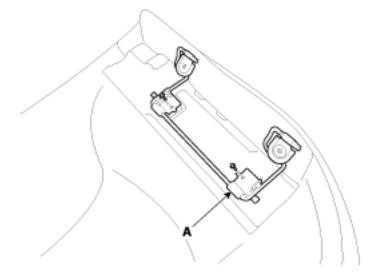
#### [LH]

## **▲** CAUTION

• Put on gloves to protect your hands.

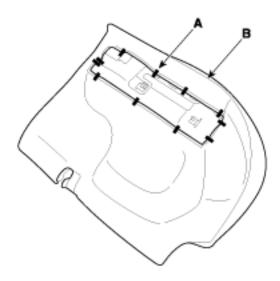
## **NOTICE**

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the rear seat cushion assembly.
   (Refer to Rear Seat "Rear Seat Assembly")
- 2. After loosening the mounting bolts, then remove the rear cushion tilt assembly (A).

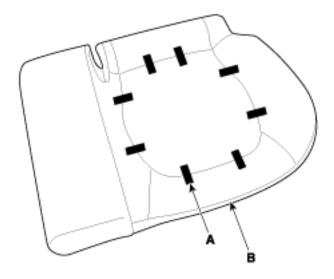


3. After removing the velcro tape and hog-ring clips (A) on the rear of seat cushion and remove the rear seat cushion cover (B).

#### [Rear side]



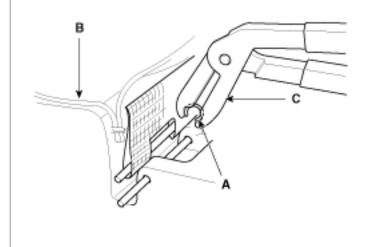
### [Front side]



4. Install in the reverse order of removal.

## i Information

- To prevent wrinkles, make sure the material is stretched evenly over the cover (B) before securing the hog-ring clips (A).
- Replace the hog-ring clips with new ones using special tool (C) (09880-4F000).



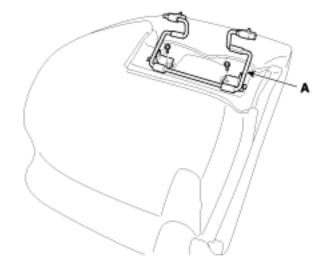
### [RH]

# **▲** CAUTION

• Put on gloves to protect your hands.

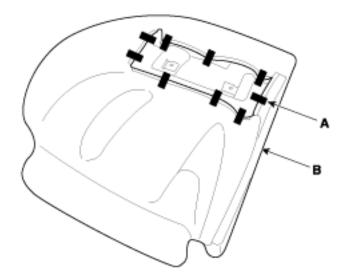
#### NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the rear seat cushion assembly.
   (Refer to Rear Seat "Rear Seat Assembly")
- 2. After loosening the mounting bolts, then remove the rear cushion tilt assembly (A).

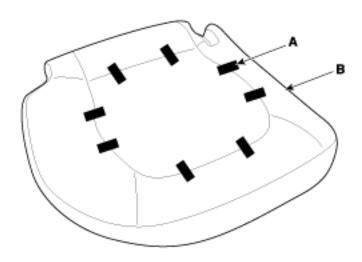


3. After removing the velcro tape and hog-ring clips (A) on the rear of seat cushion and remove the rear seat cushion cover (B).

## [Rear side]



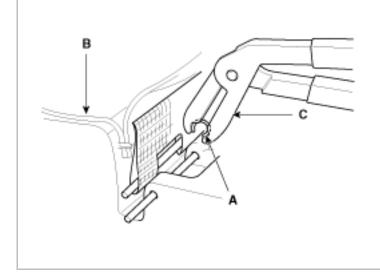
## [Front side]

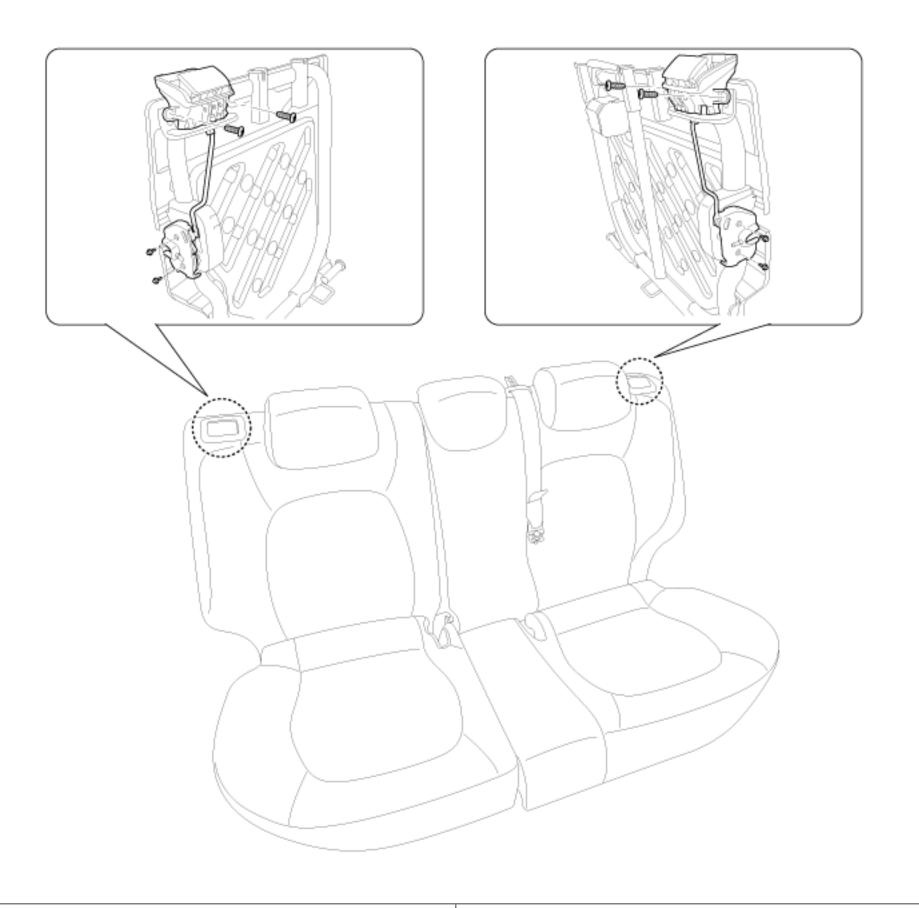


4. Install in the reverse order of removal.

# i Information

- To prevent wrinkles, make sure the material is stretched evenly over the cover (B) before securing the hog-ring clips (A).
- Replace the hog-ring clips with new ones using special tool (C) (09880-4F000).





1. Rear seat latch [RH]

2. Rear seat latch [LH]

### [LH]

## **▲** CAUTION

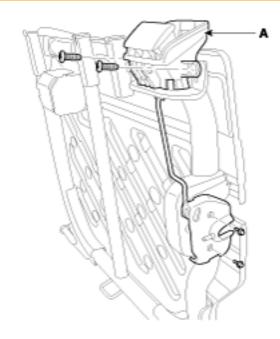
• Put on gloves to protect your hands.

### **NOTICE**

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the rear seat back cover.
   (Refer to Rear Seat "Rear Seat Back Cover")
- 2. After loosening the mounting bolts and screws, then remove the rear seat latch (A).

#### **Tightening torque:**

16.7 ~ 25.5N.m (1.7 ~ 2.6kgf.m, 12.3~18.8lb-ft)



3. Install in the reverse order of removal.



Replace any damaged clips.

### [RH]

## **▲** CAUTION

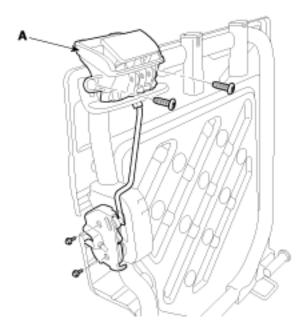
• Put on gloves to protect your hands.

## NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the rear seat back cover.
   (Refer to Rear Seat "Rear Seat Back Cover")
- 2. After loosening the mounting bolts and screws, then remove the rear seat latch (A).

### Tightening torque:

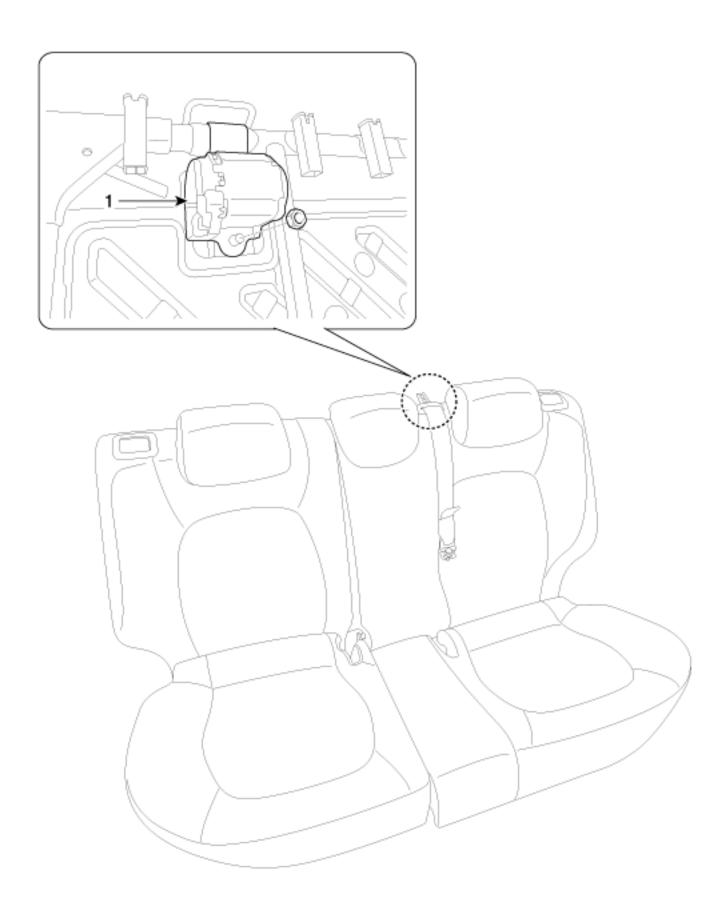
16.7 ~ 25.5N.m (1.7 ~ 2.6kgf.m, 12.3~18.8lb-ft)



3. Install in the reverse order of removal.



· Replace any damaged clips.



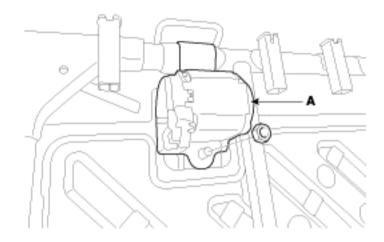
1. Rear center seat belt retractor

## NOTICE

- When installing the belt, make sure not to damage the retractor.
- Remove the rear seat back cover [LH].
   (Refer to Rear Seat "Rear Seat Back Cover")
- 2. After loosening the mounting nut, then remove the rear center seat belt retractor (A).

### **Tightening torque:**

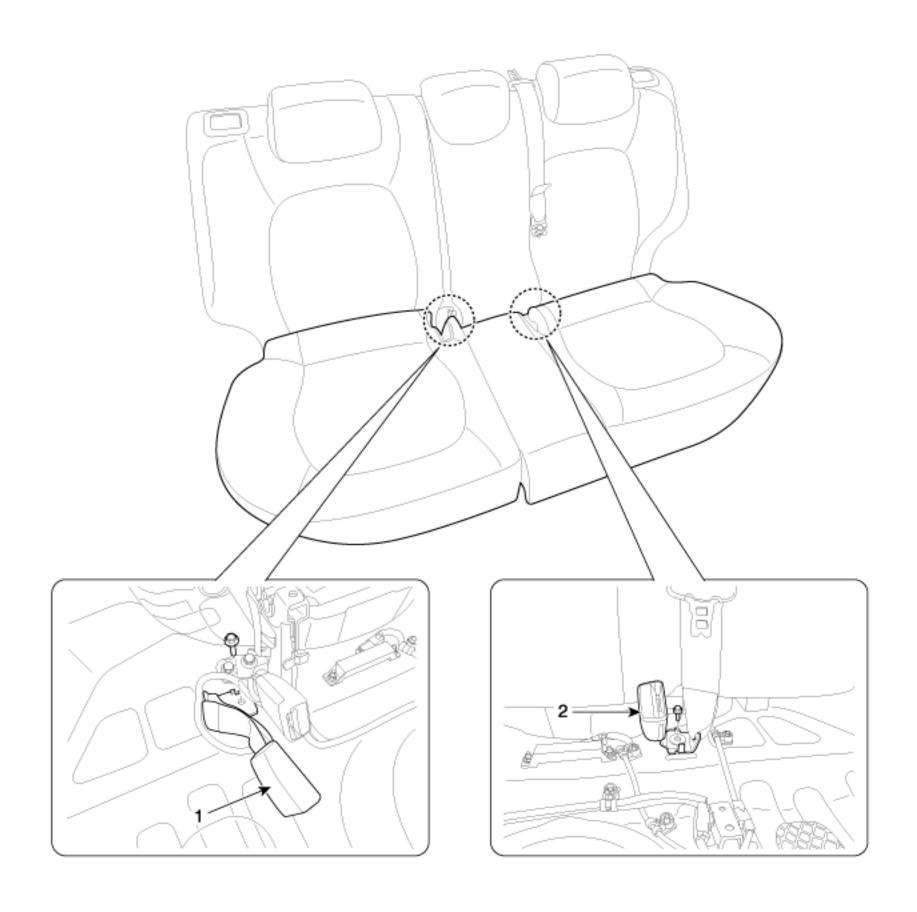
39.2 ~ 53.9 N.m (4.0 ~ 5.5 kgf.m, 28.8 ~ 39.8 lb-ft)



3. Install in the reverse order of removal.

# i Information

Replace any damaged clips.



1. Rear seat belt buckle [RH]

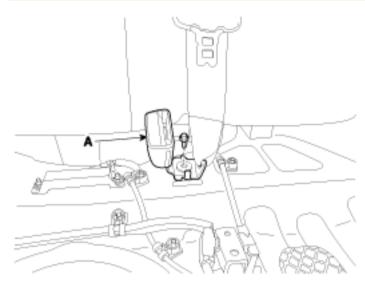
2. Rear seat belt buckle [LH]

- Remove the rear seat cushion assembly.
   (Refer to Rear Seat "Rear Seat Assembly")
- 2. Loosen the mounting bolt, and then remove the rear seat belt buckle (A).

### [LH]

## Tightening torque:

39.2 ~ 53.9 N.m (4.0 ~ 5.5 kgf.m, 28.8 ~ 39.8 lb-ft)



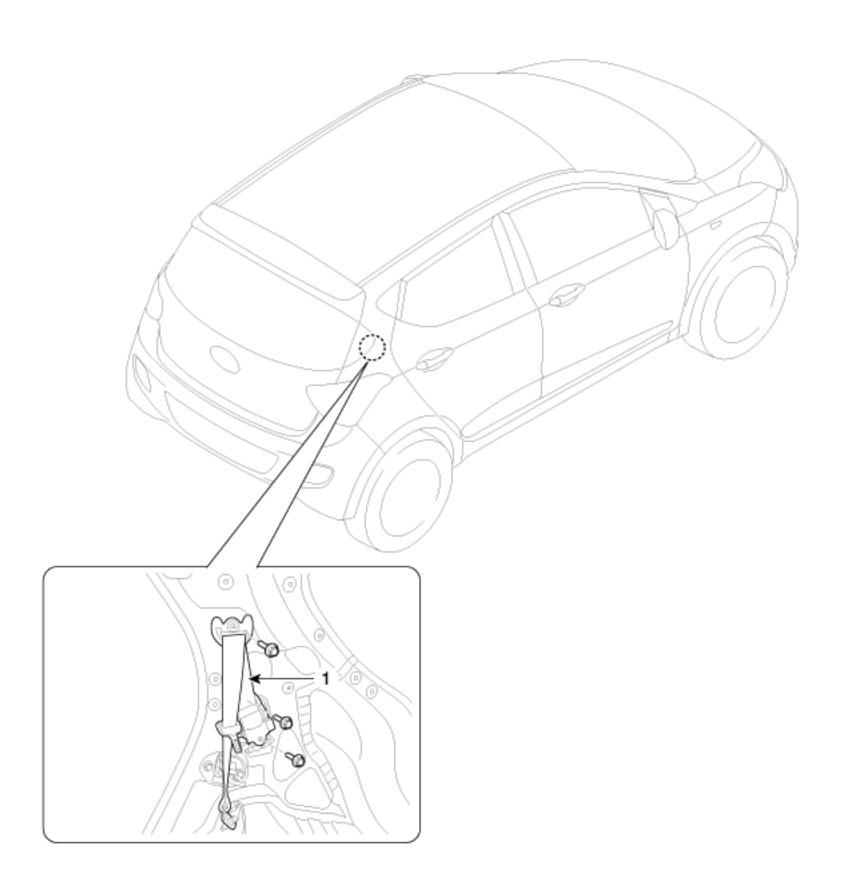
## [RH]

## Tightening torque:

39.2 ~ 53.9 N.m (4.0 ~ 5.5 kgf.m, 28.8 ~ 39.8 lb-ft)



3. Install in the reverse order of removal.



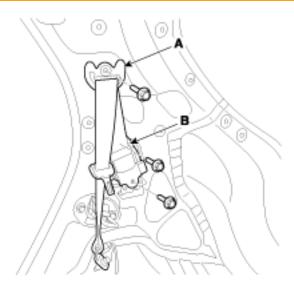
1.Rear seat belt retractor

## NOTICE

- When installing the belt, make sure not to damage the retractor.
- Remove the rear pillar trim.
   (Refer to Interior Trim "Rear Pillar Trim")
- 2. After loosening the mounting bolt, then remove the second row seat belt upper anchor (A) and the rear seat belt retractor (B).

### **Tightening torque:**

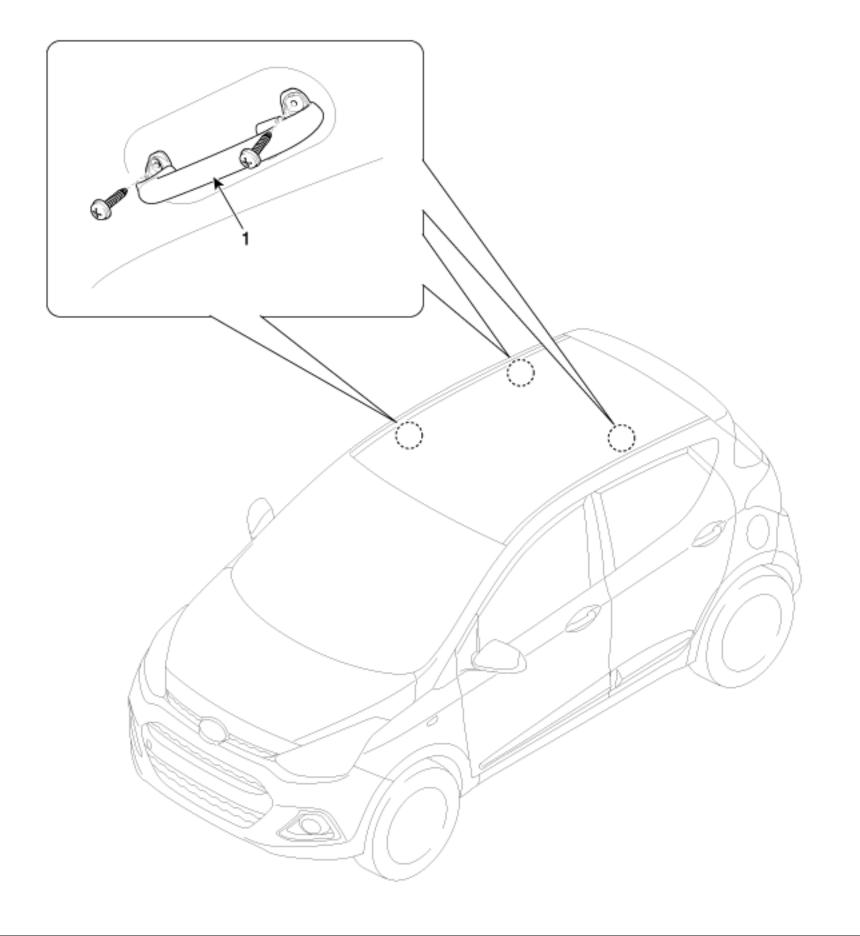
39.2 ~ 53.9 N.m (4.0 ~ 5.5 kgf.m, 28.8 ~ 39.8 lb-ft)



3. Install in the reverse order of removal.

## 1 Information

- Make sure the connector is plugged in properly.
- Replace any damaged clips.



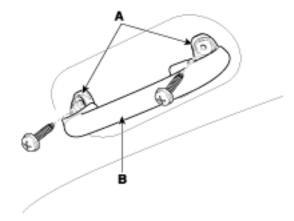
1. Assist handle

# **▲** CAUTION

• Put on gloves to protect your hands.

## NOTICE

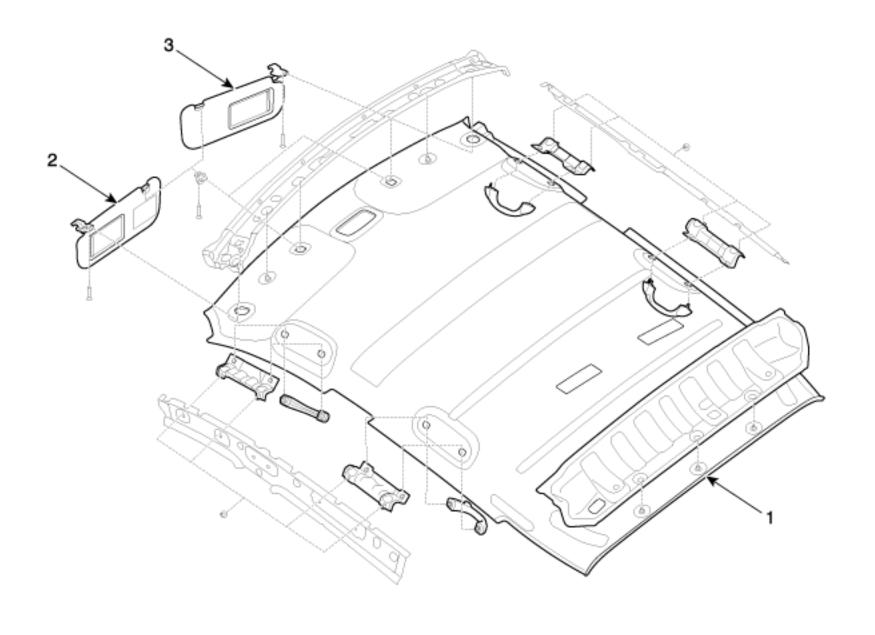
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. Remove the caps (A) and bolts, then remove the assist handle (B).



2. Install in the reverse order of removal.

# **COMPONENTS**

# [General Type]

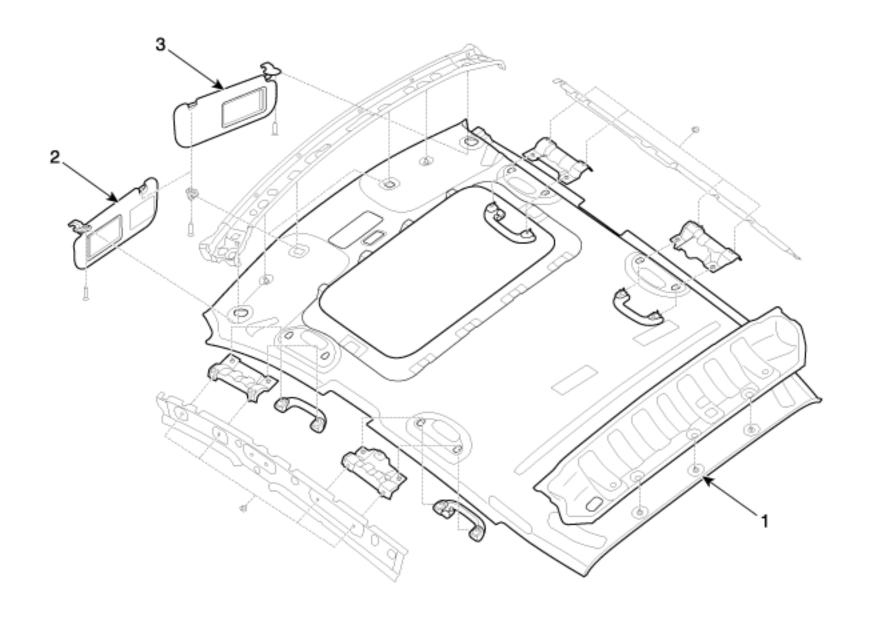


1. Roof trim

2. Sunvisor [LH]

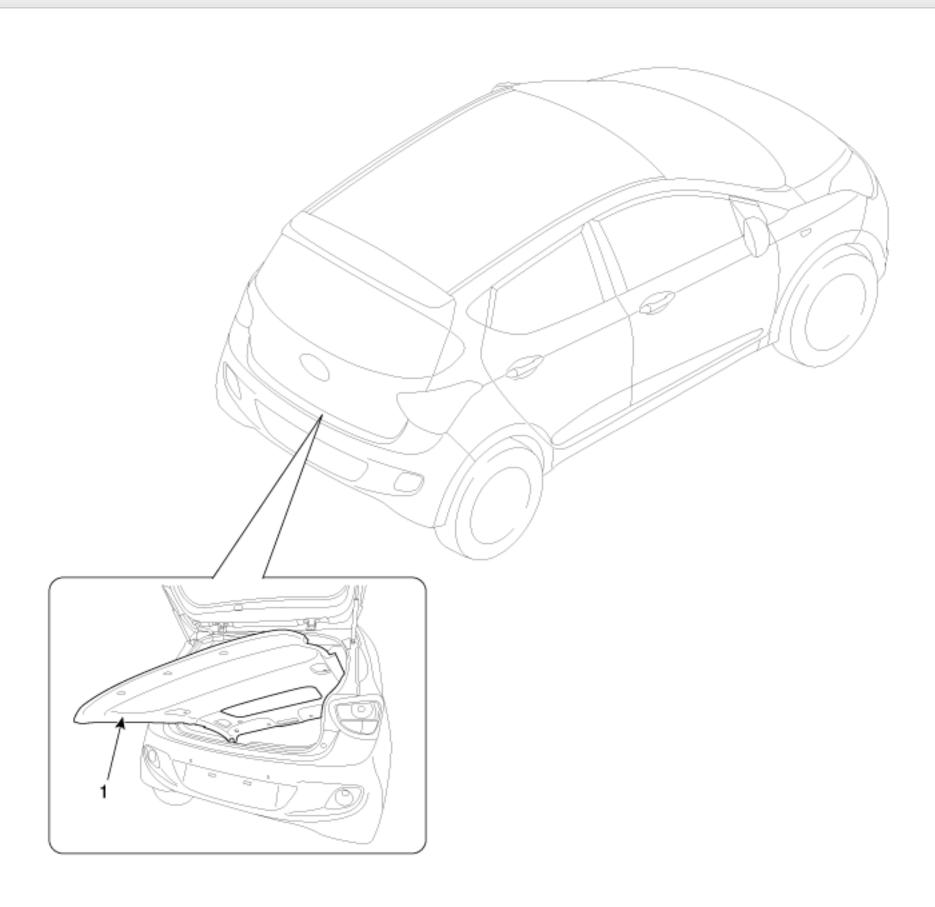
3. Sunvisor [RH]

# [Sunroof Type]



1. Roof trim 2. Sunvisor [LH]

3. Sunvisor [RH]



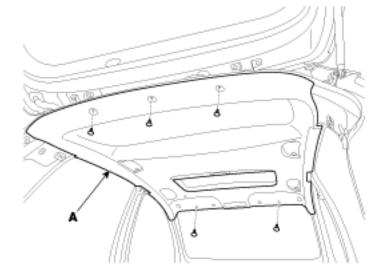
1. Roof Trim Assembly

## **▲** CAUTION

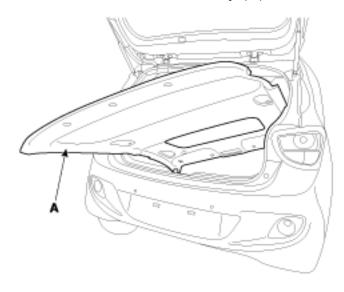
Put on gloves to protect your hands.

### NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the front seat assembly.
   (Refer to Front Seat "Front Seat Assembly")
- Remove the rear seat assembly. (Refer to Rear Seat - "Rear Seat Assembly")
- Remove the front pillar trim.(Refer to Interior Trim "Front Pillar Trim")
- Remove the canter pillar upper trim.
   (Refer to Interior Trim "Center Pillar Trim")
- Remove the rear pillar trim.(Refer to Interior Trim "Rear Pillar Trim")
- Remove the sunvisor and retainer. (Refer to Roof Trim - "Sunvisor")
- Remove the assist handle.
   (Refer to Roof Trim "Assist Handle")
- Remove the overhead console lamp.
   (Refer to Body Electrical System "Overhead Console Lamp")
- Remove the room lamp.
   (Refer to Body Electrical System "Room Lamp")
- 10. Detach the mounting clips, remove the roof trim (A).



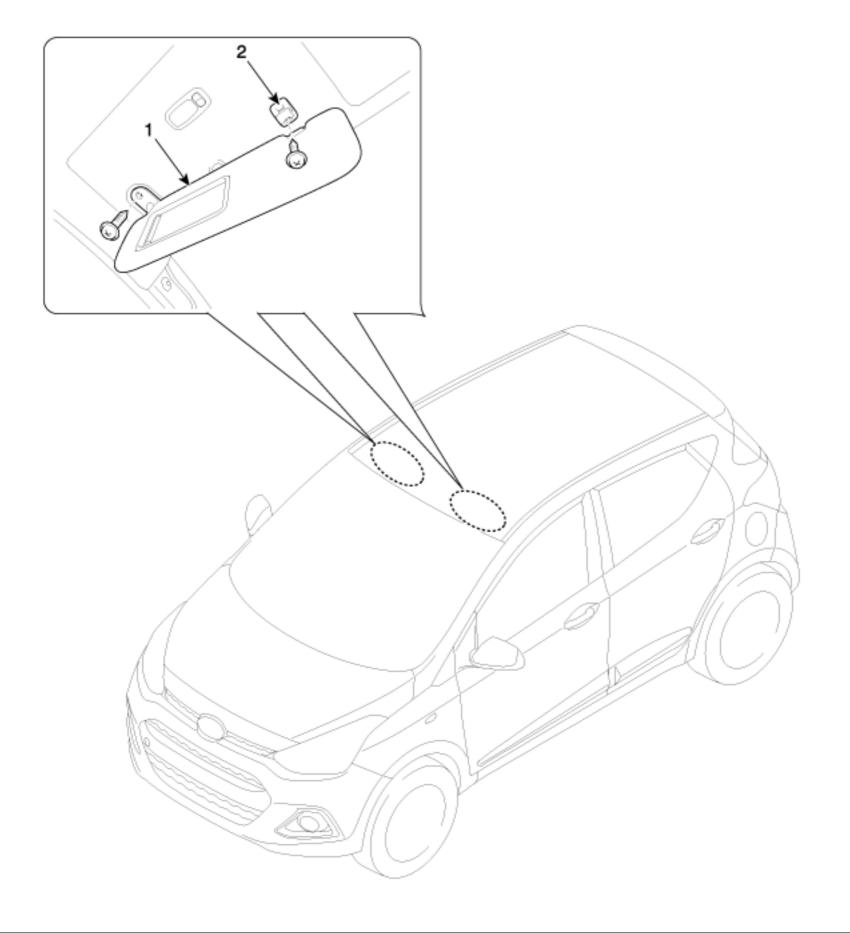
11. Remove the roof trim assembly (A) from the vehicle through the tail gate.



12. Install in the reverse order of removal.



- Make sure the connector is plugged in properly.
- Replace any damaged clips.



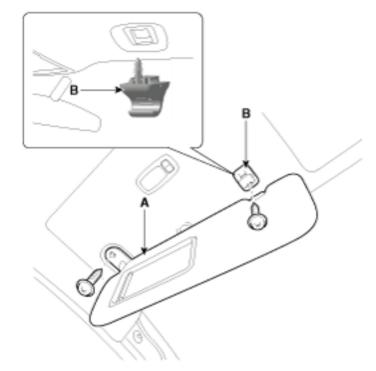
1. Sunvisor 2. Retainer

## **▲** CAUTION

• Put on gloves to protect your hands.

## NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. Loosen the mounting screws, then remove the sunvisor (A) and retainer (B).

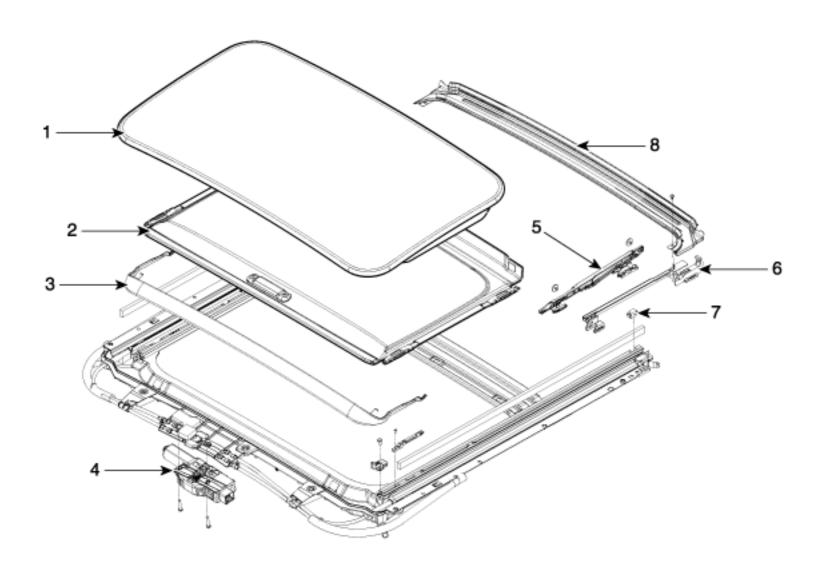


2. Install in the reverse order of removal.



Replace any damaged clips.

## **COMPONENTS**



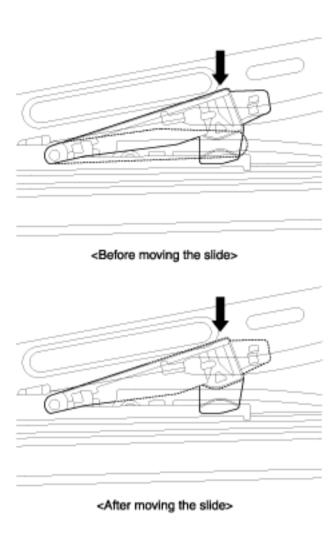
- 1. Glass panel assembly
- 2. Sunshade assembly
- 3. Deflector
- 4. Motor assembly

- 5. Rail guide assembly
- 6. Rail drip link
- 7. Stopper
- 8. Drip rail assembly

#### **ADJUSTMENT**

#### **How To Initialize**

- 1. Check that the glass has been installed.
  - · Finished height adjustment.
- 2. Push the close switch. (Keep on pushing the switch)
  - Press and hold the CLOSE button for more than 10 seconds until the sunroof moves up to the tilt position.



- 3. Release the sunroof CLOSE button with in 3 seconds. And then press and hold the CLOSE button once again within 3 seconds until the sunroof do as follows;
  - Tilt up → Slide Open → Slide Close
- 4. Then release the lever.
- 5. When the sunroof is closed completely, turn OFF the UP switch initialize the motor completely.

#### When To Initialize The Motor

- 1. After initial vehicle assembly.
- 2. If the initial value is erased or damaged because of short power electric discharge during operation.
- 3. After using the manual handle.

### Operating The Sunroof Emergency Handle

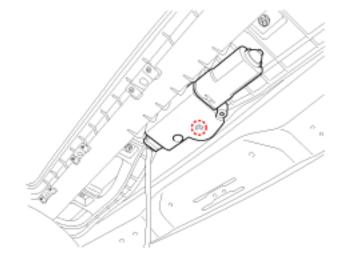
1. Use the sunroof emergency handle to close or open the sunroof manually if the sunroof cannot be closed electronically due to motor or controller electrical malfunction.

## 2. Operating method.

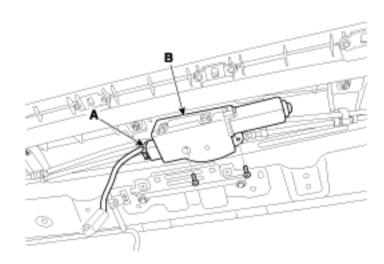
- · Remove the roof trim.
- Push the emergency handle up into the hexagonal drive (A) of the sunroof motor. You must push hard enough to disengage the motor clutch; otherwise the emergency handle will slip due to incomplete fit in the motor.
- · Carefully turn the emergency handle clockwise to close the sunroof.
- After closing the sunroof, wiggle the handle back and forth as you remove the tool from the motor, to ensure the motor clutch reengages.
- A 5mm hex socket may be used in place of the emergency handle, with a" Speeder" type handle.

### **▲** CAUTION

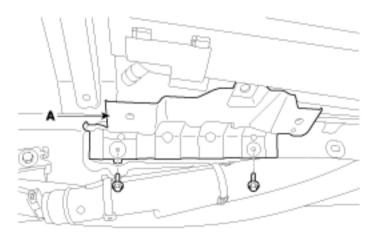
- Do not use power tools to operate the sunroof.
- Damage to the components may occur.



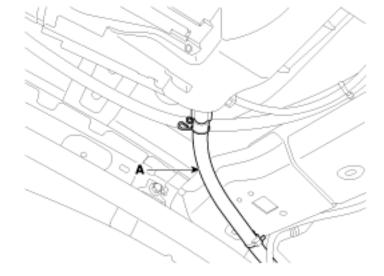
- Remove the roof trim.
   (Refer to Roof Trim "Roof Trim Assembly")
- 2. Remove the sunroof glass. (Refer to Sunroof "Sunroof Glass")
- 3. Disconnect the sunroof glass motor connecter (A).
- 4. After loosening the mounting screws, then remove the sunroof glass motor (B).



- Remove the curtain airbag (CAB) module.
   (Refer to Restraint "Curtain Airbag (CAB) Module")
- 6. Loosen the assist handle bracket (A) mounting bolts.



7. Disconnect the drain tubes (A).



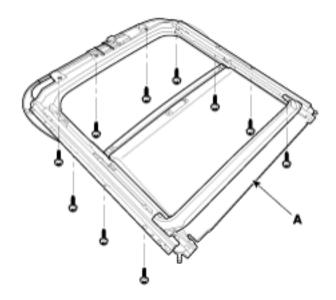
8. After loosening the mounding bolts, remove the sunroof assembly (A).

# **▲** CAUTION

• Take care not to scratch the interior trims and other parts.

### Tightening torque:

6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)

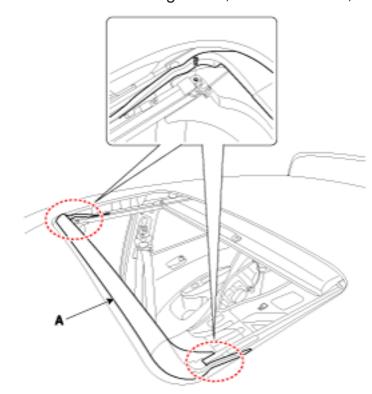


9. Install in the reverse order of removal.

## **▲** CAUTION

• Make sure to initialize the motor.

- 1. Open the glass fully.
- 2. Loosen the mounting screw, from the frame, and then remove the deflector (A).



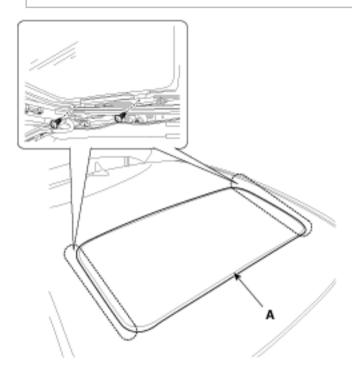
3. Install in the reverse order of removal.

# NOTICE

- Put on glove to protect your hands.
- 1. Remove the glass (A) by lifting it up.

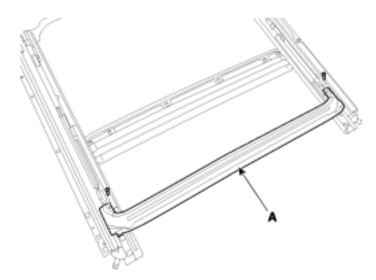
# **▲** CAUTION

• Do not damage the roof panel.

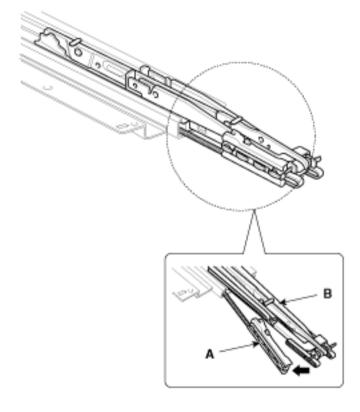


2. Install in the reverse order of removal.

- Remove the sunroof assembly.
   (Refer to Sunroof "Sunroof Assembly")
- 2. Remove the sunroof sunshade. (Refer to Sunroof "Sunroof Sunshade")
- 3. After loosening the mounting screws, then remove the drip link (A).



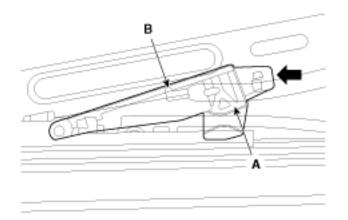
4. Remove the guide (A) and slide (B).



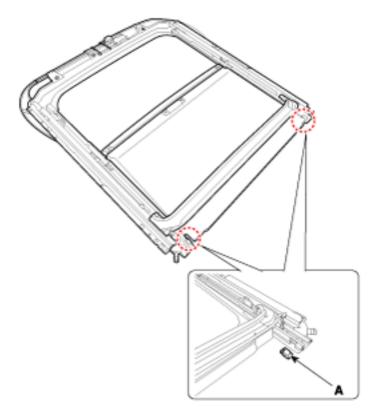
5. Install in the reverse order of removal.

## **▲** CAUTION

- Make sure to align the slide with the center of "(A)" and "(B)"
- · Make sure to initialize the motor.



- Remove the sunroof assembly.
   (Refer to Sunroof "Sunroof Assembly")
- 2. Remove the sunshade stopper (A).



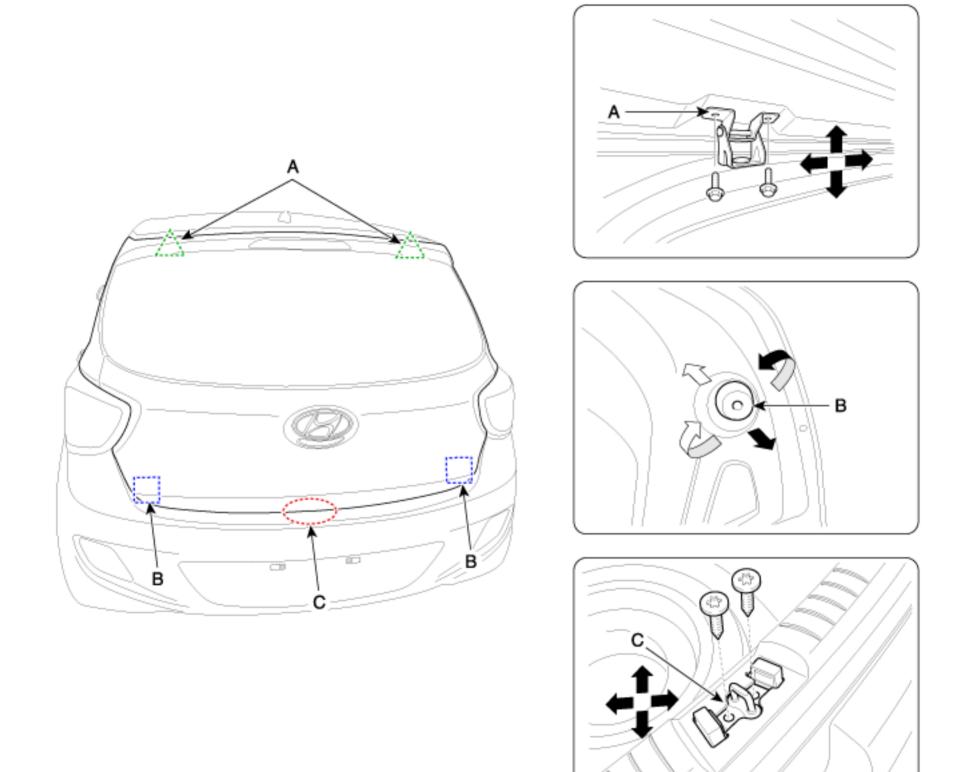
3. Install in the reverse order of removal.



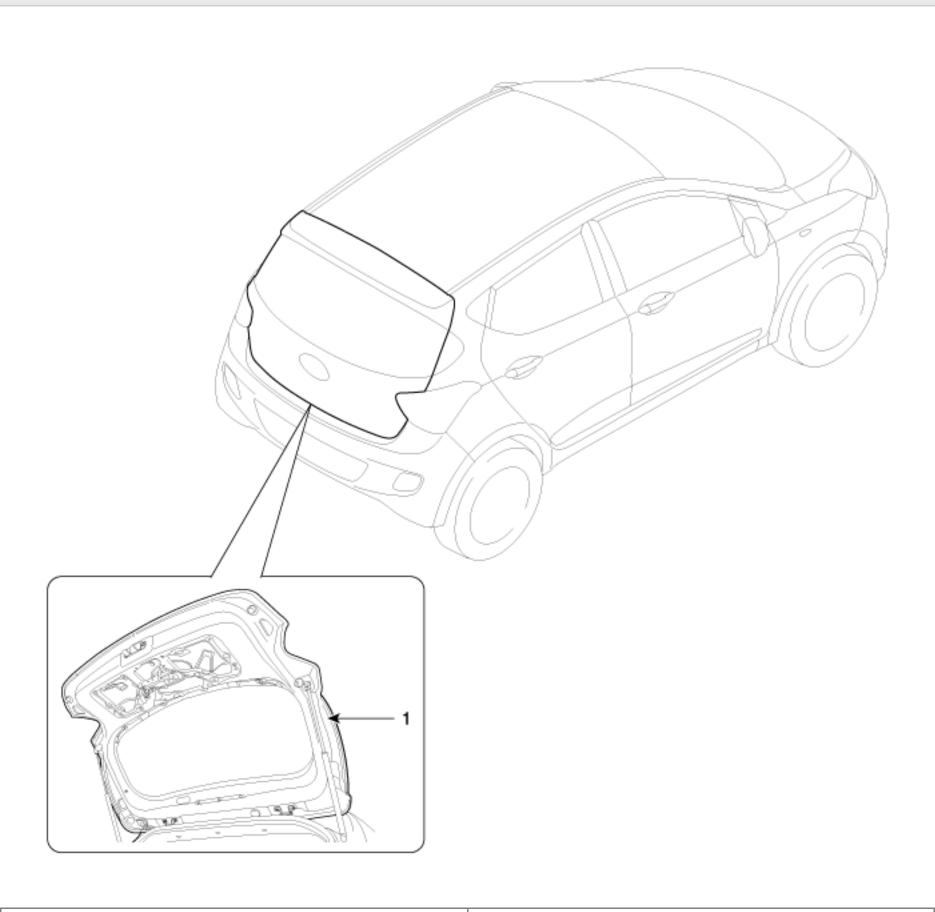
• Make sure to initialize the motor.

### **ADJUSTMENT**

- 1. After loosening the tail gate hinge (A) mounting bolt, adjust the tail gate by moving it up or down, or right or left.
- 2. Adjust the tail gate height by turning the tail gate overslam bumpers (B).
- 3. After loosening the tail gate striker (C) mounting bolts, adjust the tail gate striker by moving it up or down, or right or left.



## **COMPONENT LOCATION**



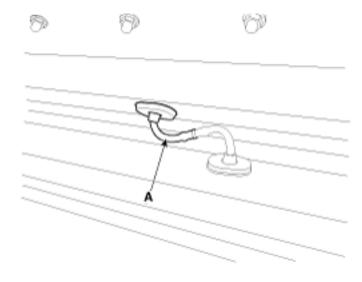
1. Tail gate assembly

# **▲** CAUTION

• Wear gloves to protect hands from injury.

## i Information

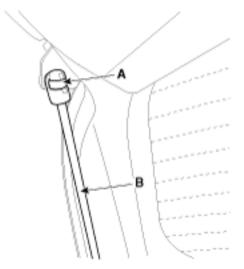
- When removing and installing the tail gate, an assistant is necessary.
- Remove the tail gate trim.
   (Refer to Tail Gate "Tail Gate Trim")
- 2. Remove the washer nozzle hose (A).



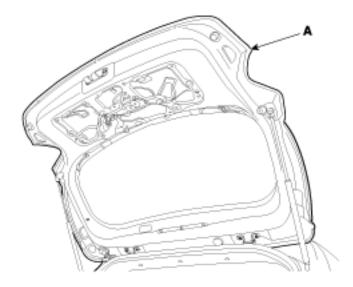
3. Disconnect the connectors and tail gate wiring harness (A).



4. Using a flat-tip screwdriver, lift the socket clips (A) up slightly on both ends of the tail gate lifter (B).



5. After loosening the mounting bolts, then remove the tail gate assembly (A).

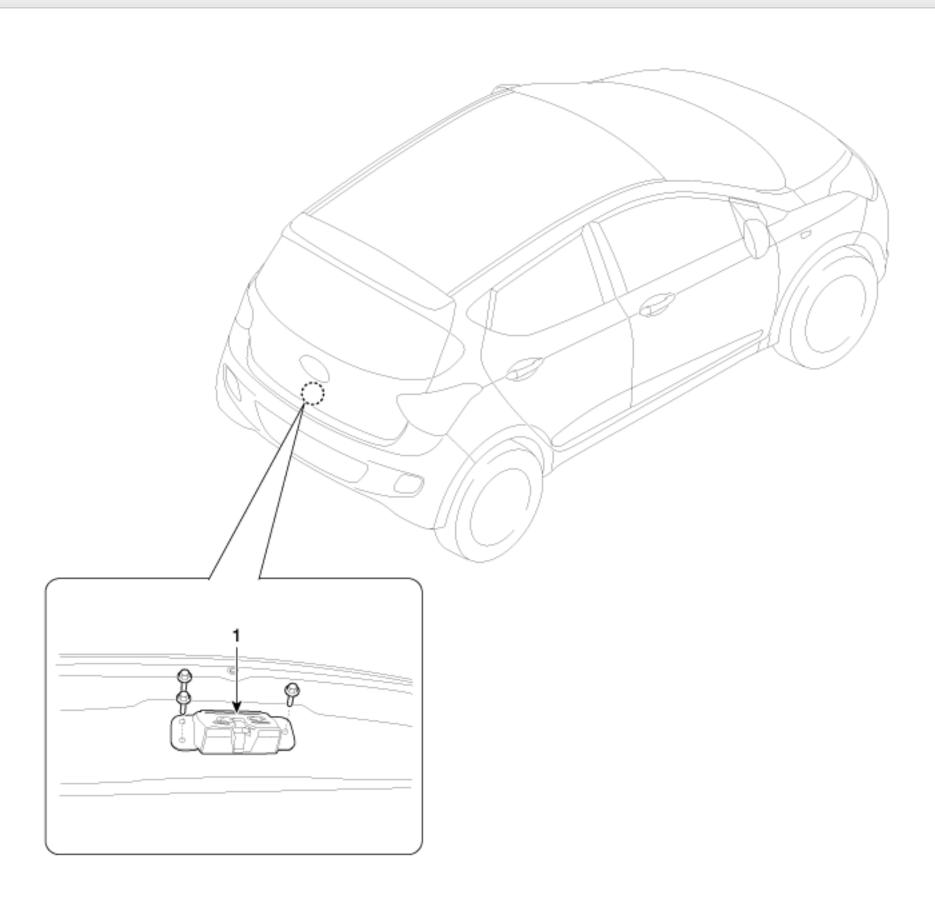


6. Install in the reverse order of removal.

## i Information

- Make sure the tail gate locks/unlocks and opens/closes properly.
- Adjust the tail gate alignment.
- Make sure the connectors are connected in properly.
- Replace any damaged clips.

## **COMPONENT LOCATION**



1. Tail gate latch assembly

## **▲** CAUTION

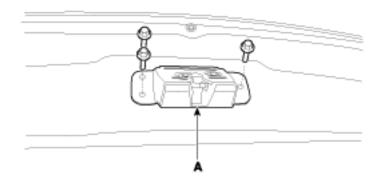
• Put on gloves to protect your hands.

### NOTICE

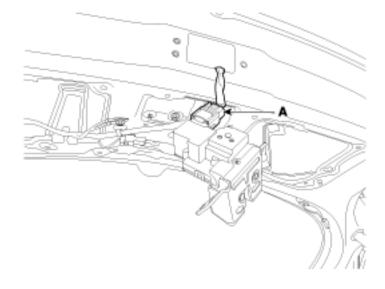
- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Take care not to scratch the body surface.
- Remove the tail gate trim.
   (Refer to Tail Gate "Tail Gate Trim")
- 2. After loosening the mounting bolts, then remove the tail gate latch assembly (A).

#### **Tightening torque:**

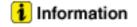
 $6.9 \sim 10.8 \text{ N.m} (0.7 \sim 1.1 \text{ kgf.m}, 5.1 \sim 8.0 \text{ lb-ft})$ 



3. Disconnect the tail gate latch connector (A).



4. Install in the reverse order of removal.

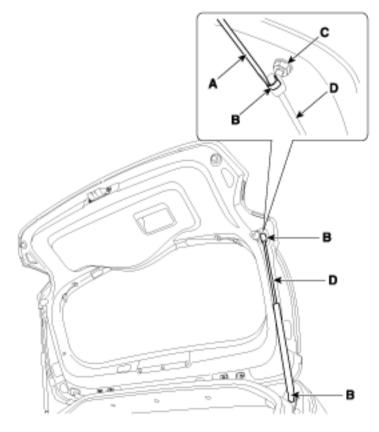


• Make sure the tail gate locks/unlocks and opens/closes properly.

- Adjust the tail gate alignment.
- Make sure the connectors are connected in properly.

### i Information

- Take care to not let the tailgate fall on you as the lifts are removed. Have a helper hold the tailgate open, or use a secure method to hold it open.
- 1. Using a screwdriver (A), lift up slightly the socket clips (B) of both ends on the lifter (D), and then remove the lifter from the bracket (C).

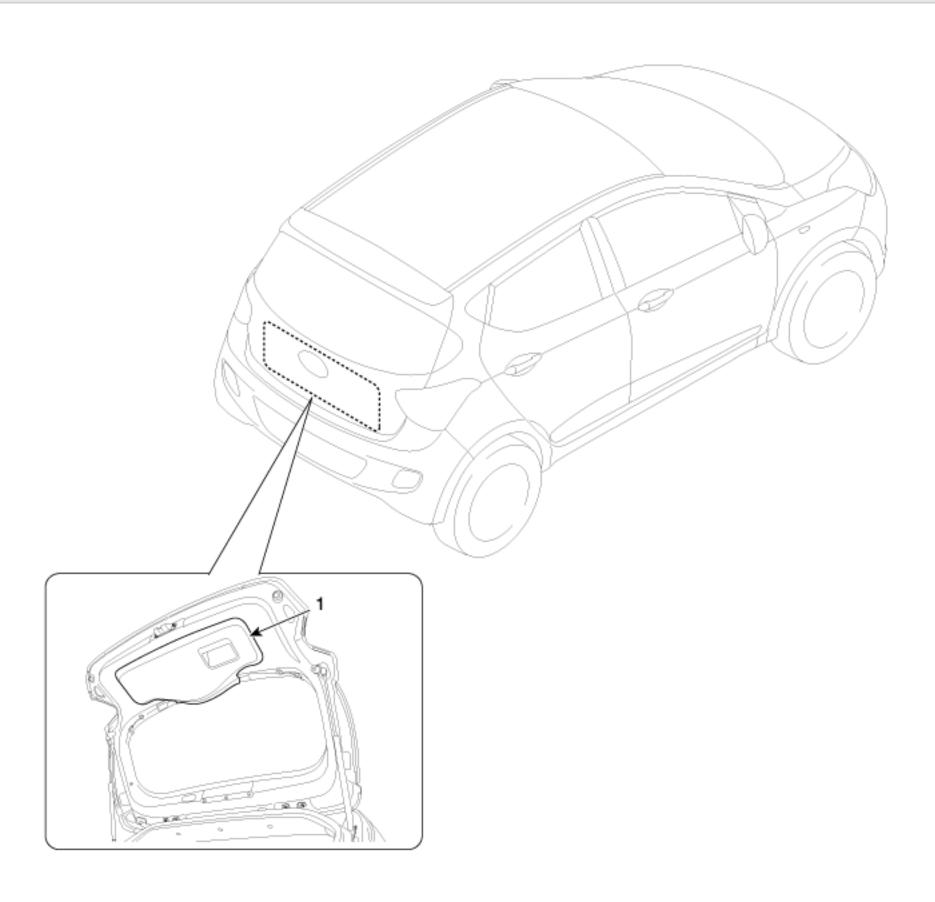


2. Install in the reverse order of removal.

# i Information

• Make sure the tail gate locks and opens properly and locks securely.

## **COMPONENT LOCATION**



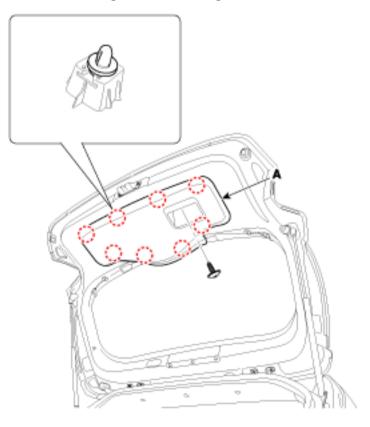
1. Tail gate trim

## **▲** CAUTION

• Put on gloves to protect your hands.

### NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Take care not to scratch the body surface.
- 1. After loosening the mounting screws, then remove the tail gate trim (A).



2. Install in the reverse order of removal.

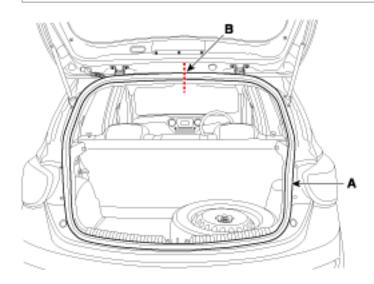


• Replace any damaged clips.

1. Remove the tail gate weatherstrip (A).

## NOTICE

• Do not apply sealant to the body.



2. Install in the reverse order of removal.



• Install the weatherstrip aligned with canter line (B).

### **▲** CAUTION

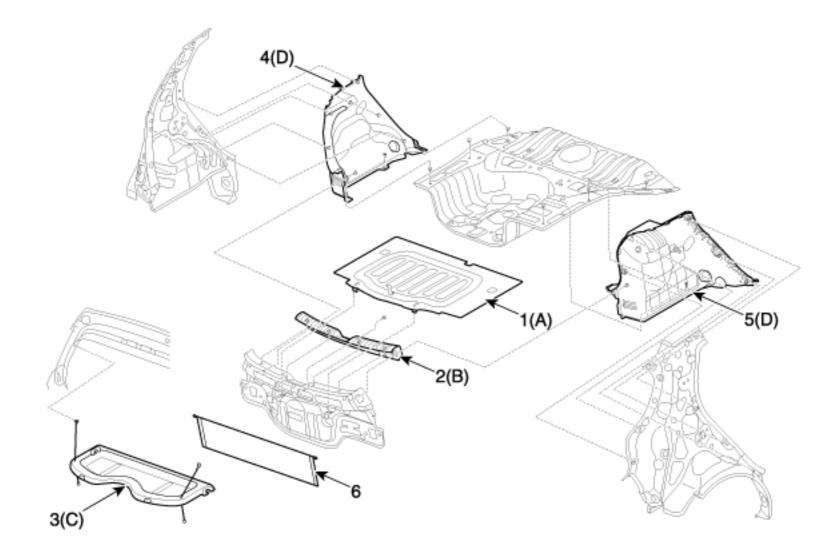
• Put on gloves to protect your hands.

### NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- Remove the rear seat assembly.
   (Refer to Rear Seat "Rear Seat Assembly")
- Remove the rear door scuff trim.(Refer to Interior Trim "Door Scuff Trim")
- 3. Remove the luggage covering board (A).
- 4. Remove the rear transverse trim (B).
- 5. Remove the covering shelf trim (C).
- 6. After loosening the mounting screws, then remove the luggage side trim (D).
- 7. Install in the reverse order of removal.

### i Information

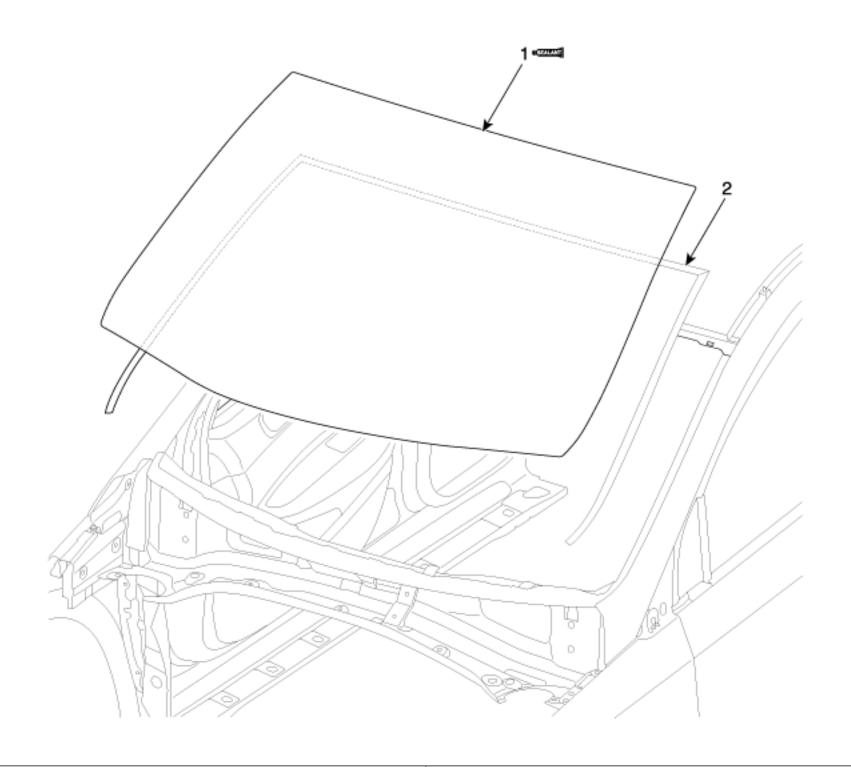
· Replace any damaged clips.



- Luggage covering board
   Rear transverse trim
- 3. Covering shelf trim

- 4. Luggage side trim [LH]5. Luggage side trim [RH]6. Luggage net assembly

## **COMPONENTS**



1. Windshield glass

2. Windshield glass molding

#### [Removal]

### **▲** CAUTION

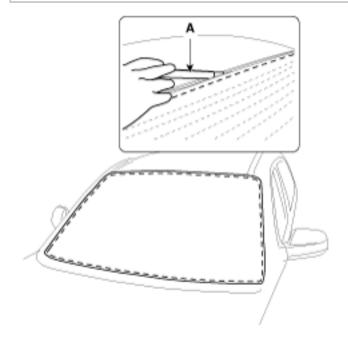
- Put on gloves to protect your hands.
- When replacing a broken windshield glass, a commercially available windshield cutter can be efficiently used for cutting adhesive. For details, follow the instructions of the tool manufacturer.

### **NOTICE**

- Use seat covers to avoid damaging any surfaces.
- Remove the front pillar trim.
   (Refer to Interior Trim "Front Pillar Trim")
- Remove the cowl top cover. (Refer to "Cowl Top Cover")
- 3. Remove the inside rear view mirror assembly. (Refer to Mirror "Inside Rear View Mirror")
- 4. Disconnect the windshield glass defogger connector.
- 5. Cut out the adhesive using a cutter (A).

### i Information

Please use a cutter with a blade length between 8-12 inches.

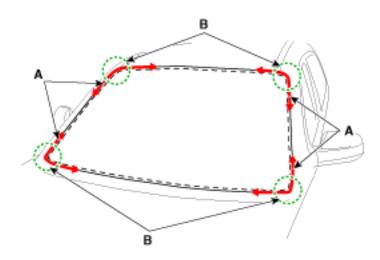


6. Cut off the sealant on the edge (B) while pulling the piano wire (A) left and right.

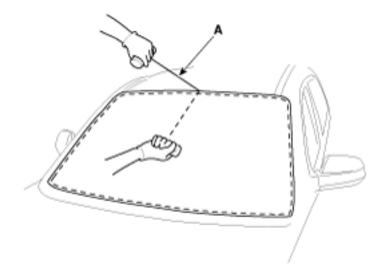
### **▲** CAUTION

• Put on gloves to protect your hands.

- Heat may occur when working on the wires. Be careful not to burn your hands.
- Be careful not to disconnect the piano wire.



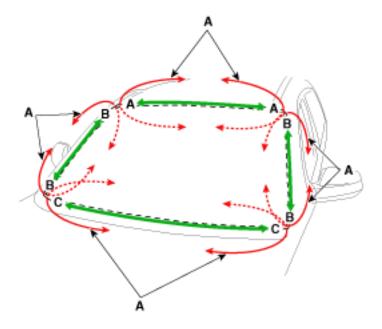
7. If a piano wire is visible inside the chassis, pull the piano wire (A) line inside.



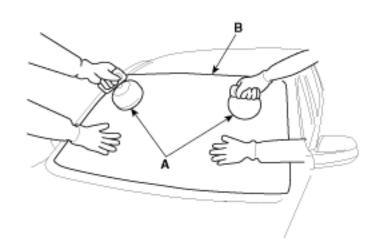
8. Cut off the sealant on (A-A), (B-B), (C-C), while pulling a piano wire (A) left and right.

## **▲** CAUTION

- Put on gloves to protect your hands.
- Heat may occur when working on the wires. Be careful not to burn your hands.
- Be careful not to disconnect the piano wire.



9. Remove the windshield glass (B) carefully using the glass holder (A).



#### [Installtion]

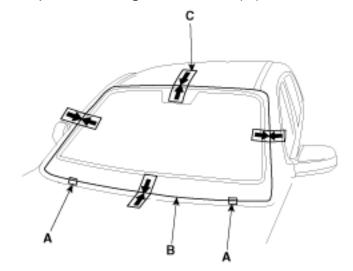
1. With a knife, scrape the old adhesive smooth to a thickness of about 2mm (0.08 in.) on the bonding surface around the entire windshield opening flange:

#### NOTICE

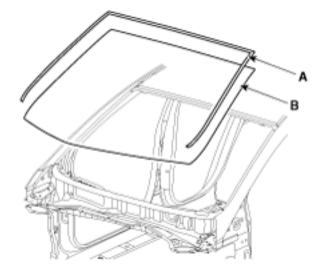
• Do not scrape down to the painted surface of the body; damaged paint will interfere with proper bonding.

### i Information

- Remove the rubber dam and fastereners from the body.
- · Mask off surrounding surfaces before painting.
- 2. Clean the bonding surface with a sponge dampened in alcohol. After cleaning, keep oil, grease and water from getting on the clean surface.
- 3. Install the spacer (A) install the windshield glass (B) temporarily with marking sure to position them on the center, and then place the alignment mark (C).



4. Peel off the tape from the windshield glass molding (A) and install the molding on the windshield glass (B).



5. With a sponge, apply a light coat of body primer to the original adhesive remaining around the windshield opening flange. Let the body primer dry for at least 10 minutes.

## i Information

- Do not apply glass primer to the body, and be careful not to mix up glass and body primer sponges.
- · Never touch the primed surfaces with your hands.
- Mask off the dashboard before painting the flange.

1//////: Primer

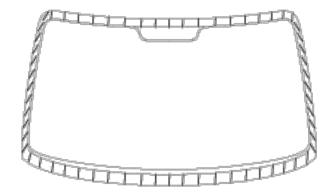


6. Apply a light coat of glass primer to the outside of the fasteners.

## information

- Never touch the primed surface with your hand. If you do, the adhesive may not bond to the glass properly, causing a leak after the windshield glass is installed.
- Do not apply body primer to the glass.
- Keep water, dust, and abrasive materials away from the primer.

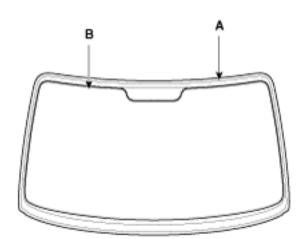
////////: Primer



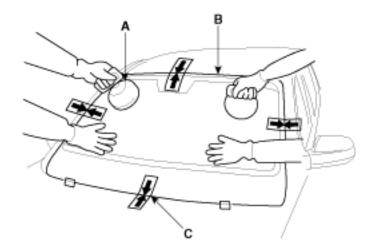
7. Pack adhesive into the cartridge without air pockets to ensure continuous delivery. Put the cartridge in a caulking gun, and run a bead of adhesive (B) around the edge of the windshield glass (A) between the fastener and molding as shown. Apply the adhesive within 30 minutes after applying the glass primer. Make a slightly thicker bead at each corner.

#### **Sealant Bead width**

Height: 12 mm (0.4724 in.) Width: 8 mm (0.3150 in.)



8. Use suction cups (A) to hold the windshield glass (B) over the opening, align it with the alignment marks (C) made in step 15, and set it down on the adhesive. Lightly push on the windshield until its edges are fully seated on the adhesive all the way around. Do not open or close the doors until the adhesive is dry.

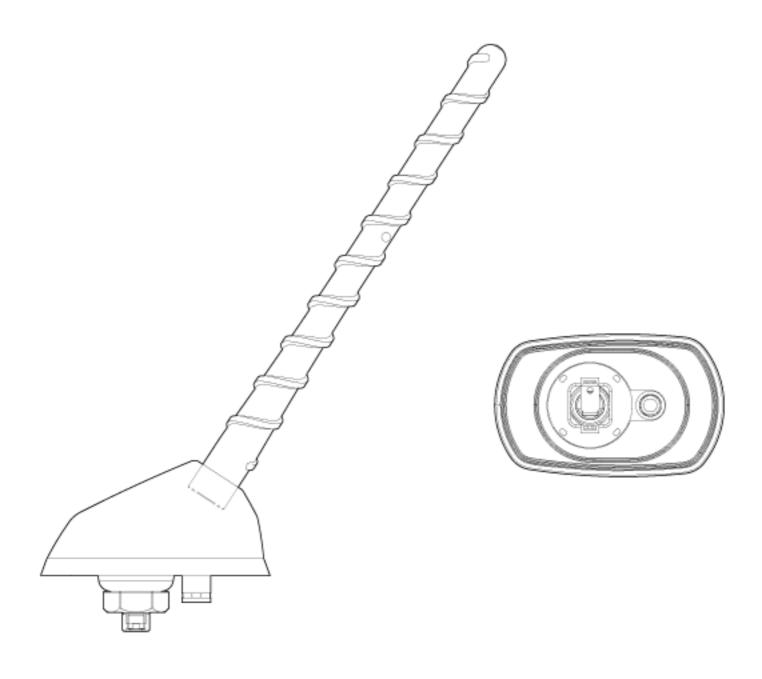


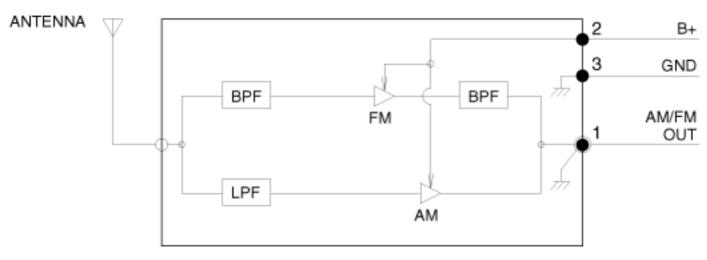
- 9. Scrape or wipe the excess adhesive off with a putty knife or towel. To remove adhesive from a painted surface or the windshield, wipe with a soft shop towel dampened with alcohol.
- 10. Let the adhesive dry for at least one hour, then spray water over the roof and check for leaks. If a leak occurs, let it dry, then seal with sealant:

#### NOTICE

- Let the vehicle stand for at least four hours after windshield installation. If the vehicle must be driven within 4 hours, it must be driven slowly.
- Keep the windshield dry for the first hour after installation.
- 11. Install the inside rear view mirror assembly.
- 12. Install the cowl top cover.
- 13. Install the front pillar trim.

### **COMPONENTS**





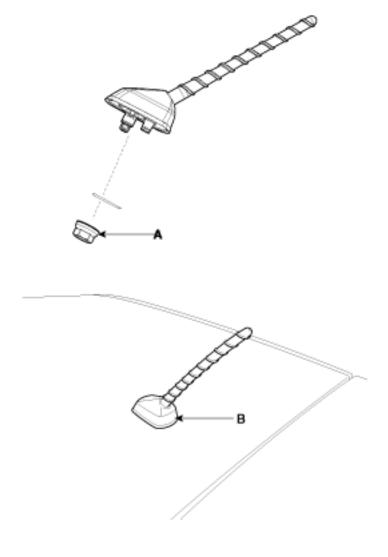
# LPF : Low Pass Filter BPF : Band Pass Filter

### **REMOVAL**

- Remove the rear roof trim.
   (Refer to Body "Roof Trim Assembly")
- 2. Disconnect the roof antenna connectors (A).



3. Remove the roof antenna (B) after loosening a nut (A).



#### **INSTALLATION**

- 1. Install the roof antenna.
- 2. Connect the roof antenna connector.
- 3. Install the rear roof trim.

# NOTICE

- Make sure that the connector are plugged in properly.
- Check the audio system.

### **INSPECTION**

1. Check the audio remote control switch (A) for resistance between terminals in each switch position.



## [Audio LH]

Switch	Connector terminal	Resistance (±5%)
Seek up	2-5	430 Ω
Seek down	2-5	1.1 kΩ
Mode	2-5	2.11 kΩ
Mute	2-5	3.11 kΩ
Volume up	2-5	4.61 kΩ
Volume down	2-5	6.81 kΩ

# [Audio only LH]

Switch	Connector terminal	Resistance (±5%)
Mute	2-5	1.0 kΩ
Volume up	2-5	2.5 kΩ
Volume down	2-5	4.9 kΩ

# [Audio only RH]

Switch	Connector terminal	Resistance (±5%)
Seek up	2-5	430 Ω
Seek down	2-5	1.1 kΩ
Mode	2-5	2.11 kΩ

## [Voice B/T]

	Connector	Resistance
Switch	Connector	Nesistance

	terminal	(±5%)
Voice	2-5	3.9 kΩ
Call off	2-5	12.1 kΩ
Call	2-5	34.1 kΩ

### **REMOVAL**

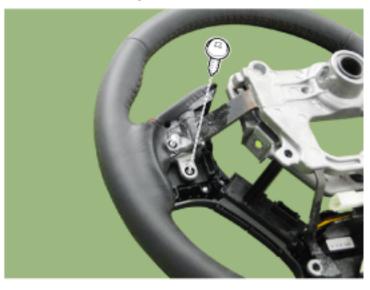
- 1. Disconnect the negative (-) battery terminal.
- Remove the driver airbag module.
   (Refer to Restraint "Driver Airbag (DAB) Module and Clock Spring")



3. Loosen the screws from steering wheel back cover (A).



4. Remo the steering wheel remote control switch (A) after loosening screws.







5. Disengage the steering wheel remote control switch assembly.

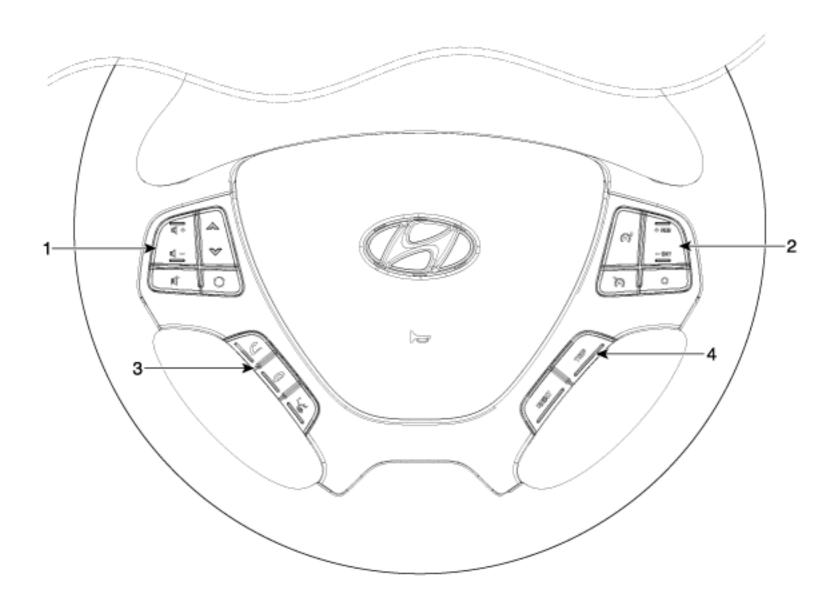
### **INSTALLATION**

- 1. Reassemble the steering wheel remote control switch after connecting the connector.
- 2. Reassemble the driver airbag module.

### NOTICE

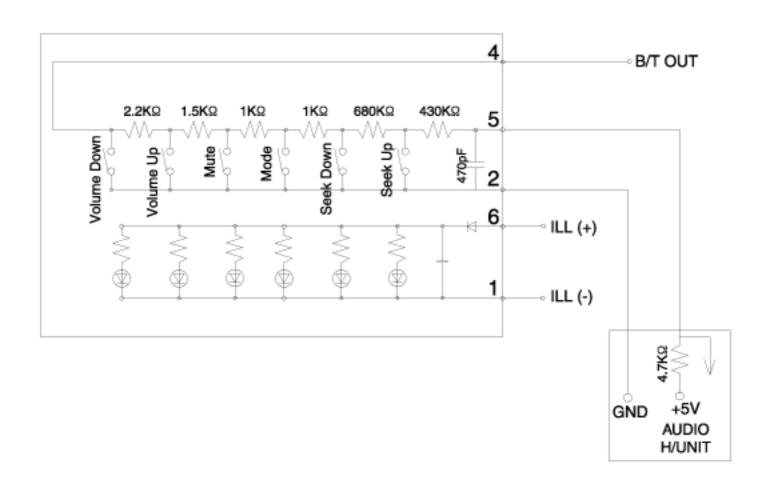
Make sure the audio remote control switch and the airbag module connectors are plugged in properly.

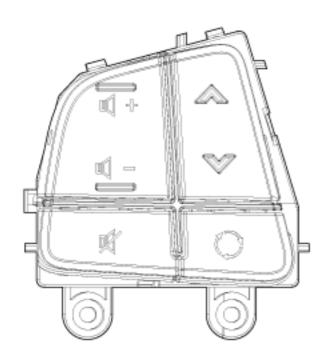
### **CIRCUIT DIAGRAM**

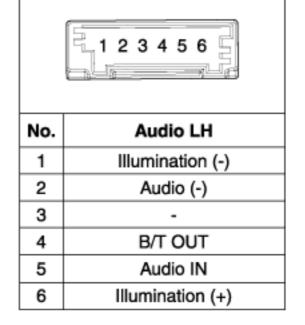


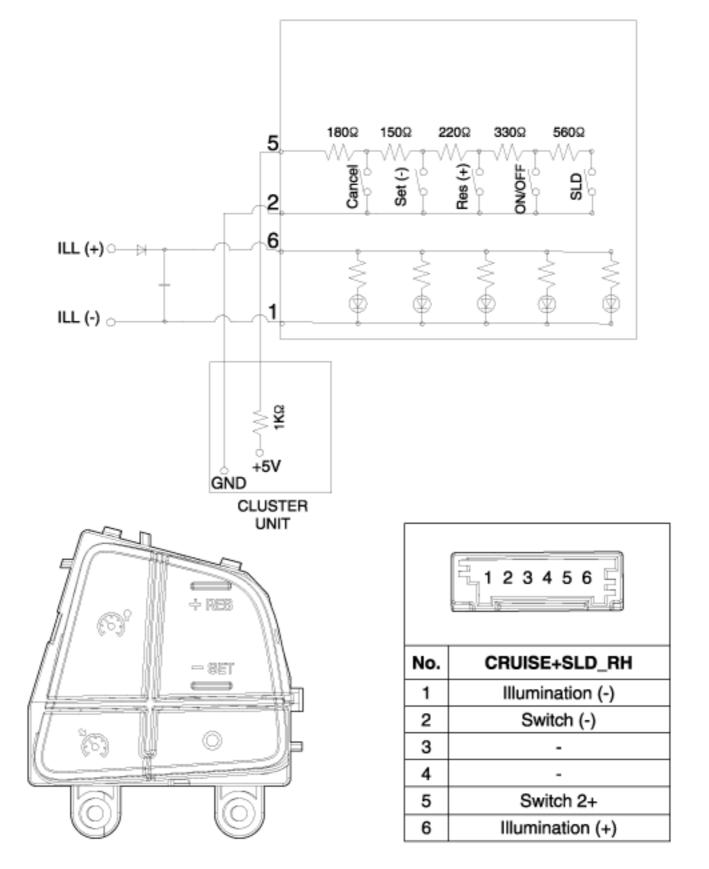
- 1. Remote control switch (LH: Audio)
- 2. Remote control switch (RH: Audio)

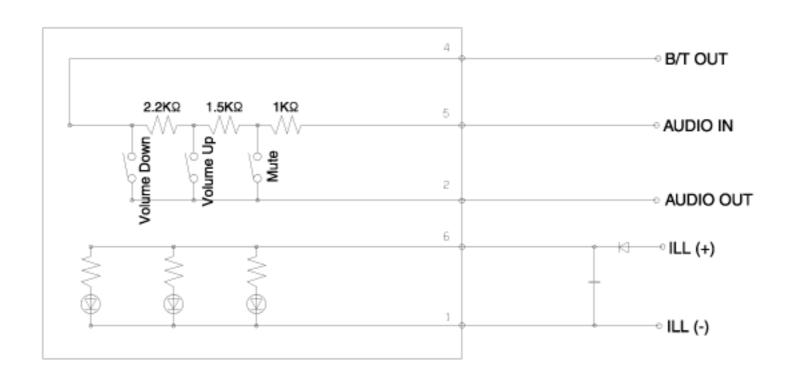
- 3. Bluetooth hands free switch
- 4. Reset and trip switch

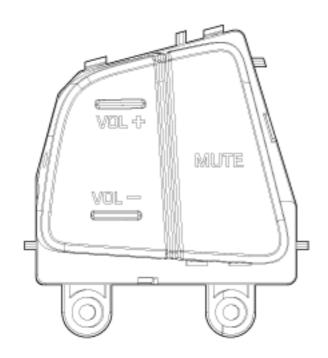


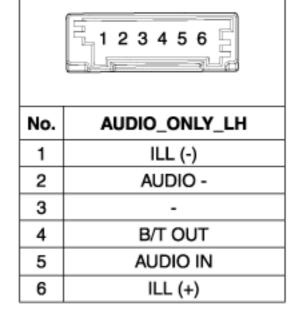


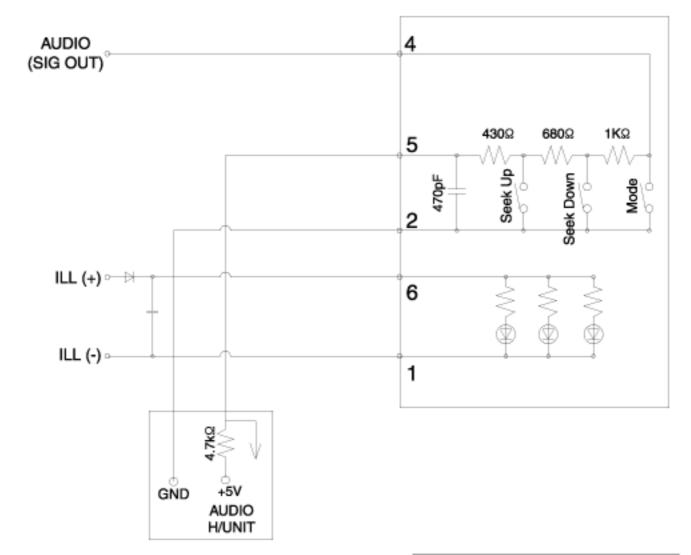


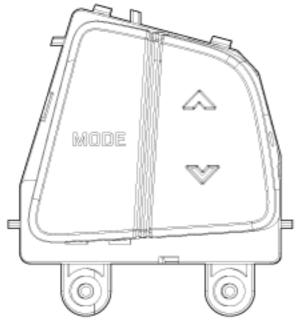


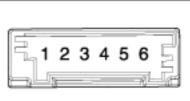




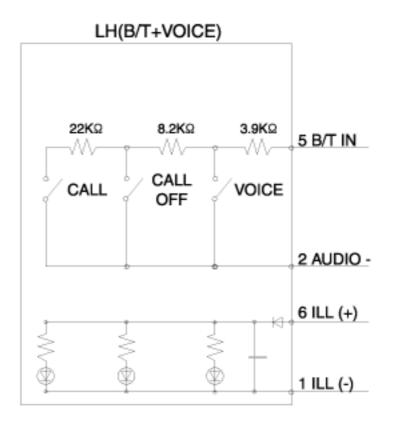


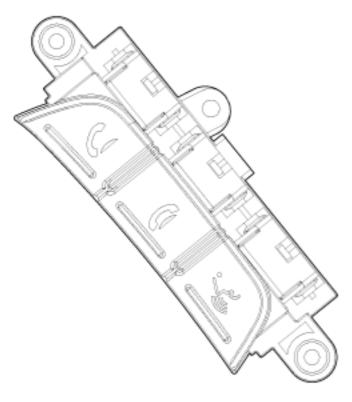


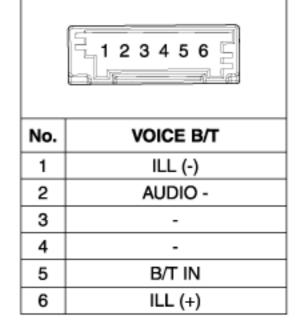


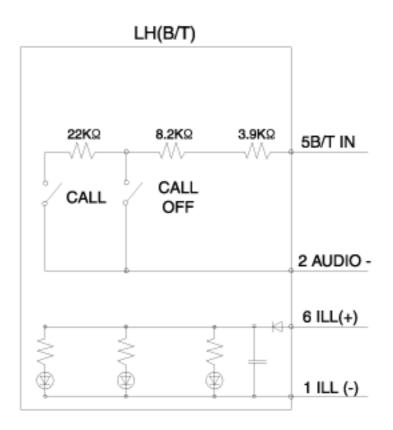


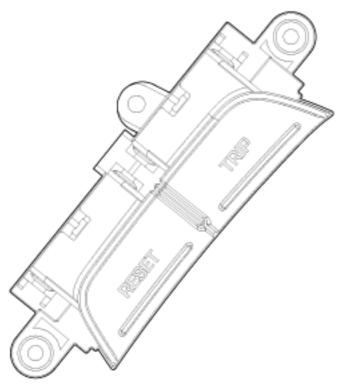
No.	AUDIO_ONLY_RH
1	ILL (-)
2	AUDIO -
3	-
4	AUDIO OUT
5	AUDIO +
6	ILL (+)

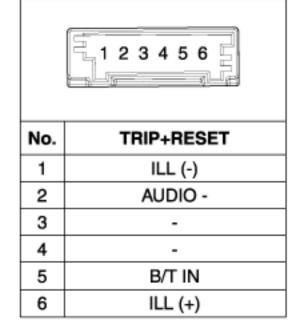




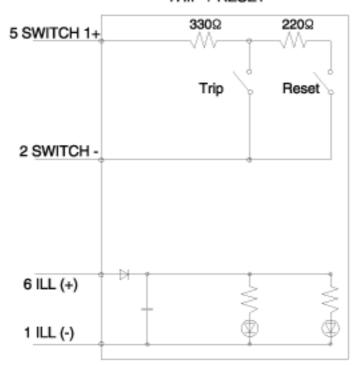


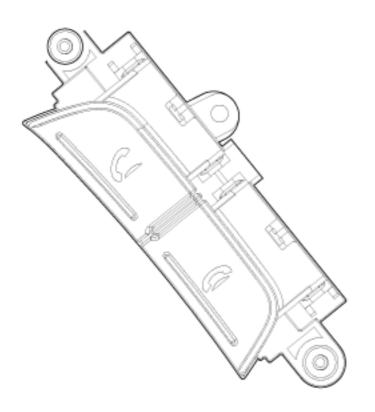


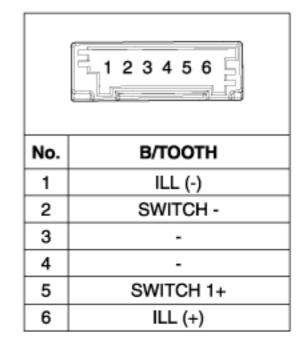




TRIP + RESET

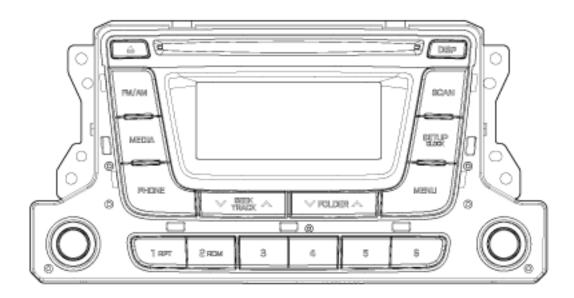


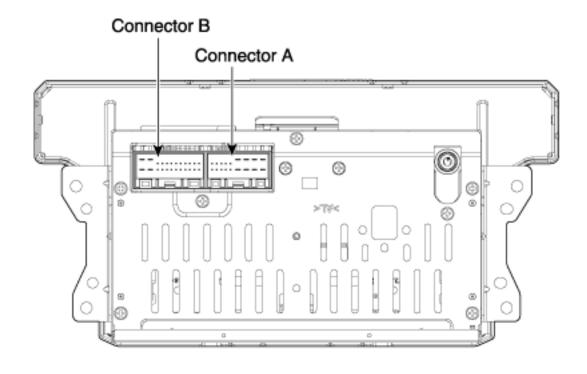


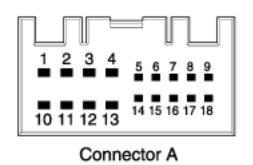


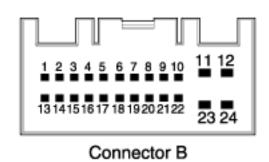
### **COMPONENTS**

# [RADIO/CD/MP3]





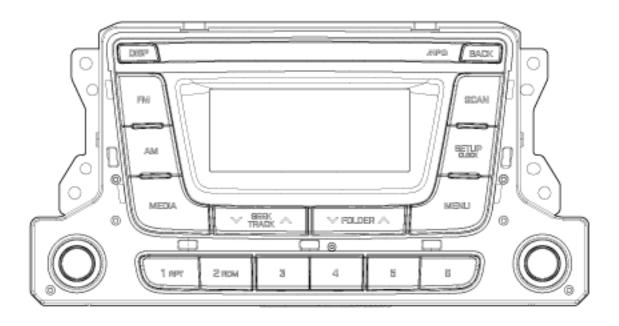


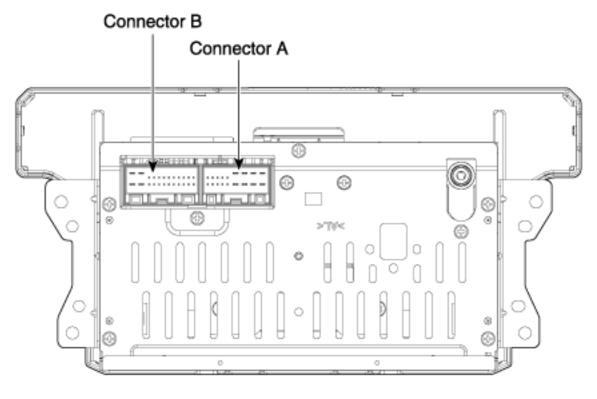


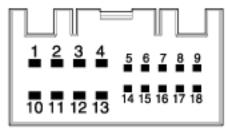
# **Connector Pin Information**

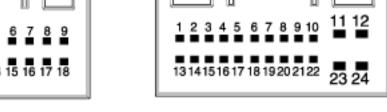
No.	Connector A	Connector B
1	Rear left speaker (+)	-
2	Front left speaker (+)	-

3	Front right speaker (+)	-
4	Rear right speaker (+)	Steering wheel remote
5	-	-
6	-	USB D (+)
7	-	USB/iPod VDD
8	Illumination (+)	AUX R IN
9	Detent (IA option)	AUX GND
10	Rear left speaker (-)	Mic (+) B/T
11	Front left speaker (-)	ACC
12	Front right speaker (-)	B+
13	Rear right speaker (-)	-
14	-	-
15	-	-
16	-	Speed
17	Illumination (-)	Remote GND
18	Remote antenna	USB D (-)
19		USB/iPod GND
20		AUX DETECT
21		AUX L IN
22		Mic (-) B/T
23		-
24		Power GND









Connector A

Connector B

# **Connector Pin Information**

No.	Connector A	Connector B
1	Rear left speaker (+)	-
2	Front left speaker (+)	-
3	Front right speaker (+)	-
4	Rear right speaker (+)	Steering wheel remote

5	-	-
6	-	USB D (+)
7	-	USB/iPod VDD
8	Illumination (+)	AUX R IN
9	Detent (IA option)	AUX GND
10	Rear left speaker (-)	Mic (+) B/T
11	Front left speaker (-)	ACC
12	Front right speaker (-)	B+
13	Rear right speaker (-)	-
14	-	-
15	-	
16		Speed
17	Illumination (-)	Remote GND
18	Remote antenna	USB D (-)
19		USB/iPod GND
20		AUX DETECT
21		AUX L IN
22		Mic (-) B/T
23		-
24		Power GND

### **REMOVAL**

# NOTICE

- Take care not to scratch the center fascia panel and related parts.
- Eject all the disc before removing the audio unit to prevent damaging the CD player's load mechanism.

# **▲** CAUTION

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Take care not to scratch the body surface.
- Put on gloves to protect your hands.
- 1. Disconnect the negative (-) battery terminal.
- 2. Using a screwdriver or remover, remove the center fascia panel (A).





3. Loosen the audio head unit mounting screws.

Remove the audio assembly (A) after disconnecting the connectors and cables (B).





# NOTICE

If the CD does not eject, do not attempt to remove it because the audio unit may be damaged. Contact an authorized dealership for assistance.

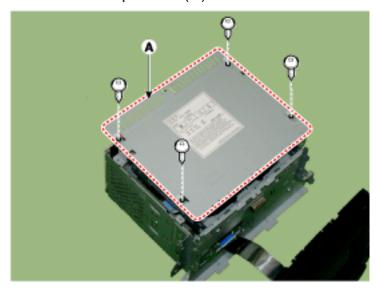
# **DISASSEMBLY**

# NOTICE

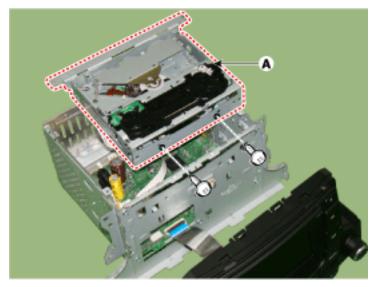
- Do not work in a dusty or dirty place.
- Do not touch the circuit board with your bare hands.
- Do not touch the terminal connector of the flat plate cable with your bare hands. (If you have touched it, wipe it off thoroughly with a soft cloth)
- If the CD-rom needs to be removed, follow the procedure below.
- 1. Disassemble the front panel (A) after loosening the screws and disengaging the hooks.



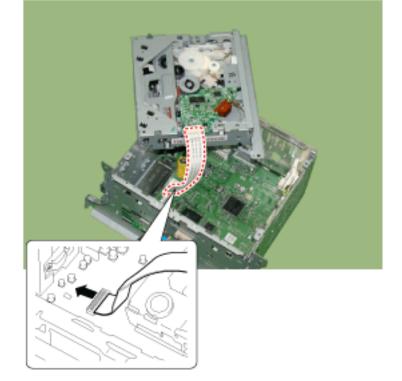
2. Remove the top cover (A) from the audio head unit after loosening the mounting screws.



3. Disassemble the CD-rom drive (A) from the audio head unit after loosening the mounting screws.



4. Disconnect the ribbon connector (A) between the unit and the drive.



# NOTICE

- Take care not to damage the ribbon connector.

#### **REASSEMBLY**

- 1. Reconnect the ribbon connector between the drive and audio head unit.
- 2. Reassemble the CD-rom drive to the audio unit.
- 3. Reassemble the top cover.

### NOTICE

Make sure the ribbon connector and cable jack are plugged in properly.

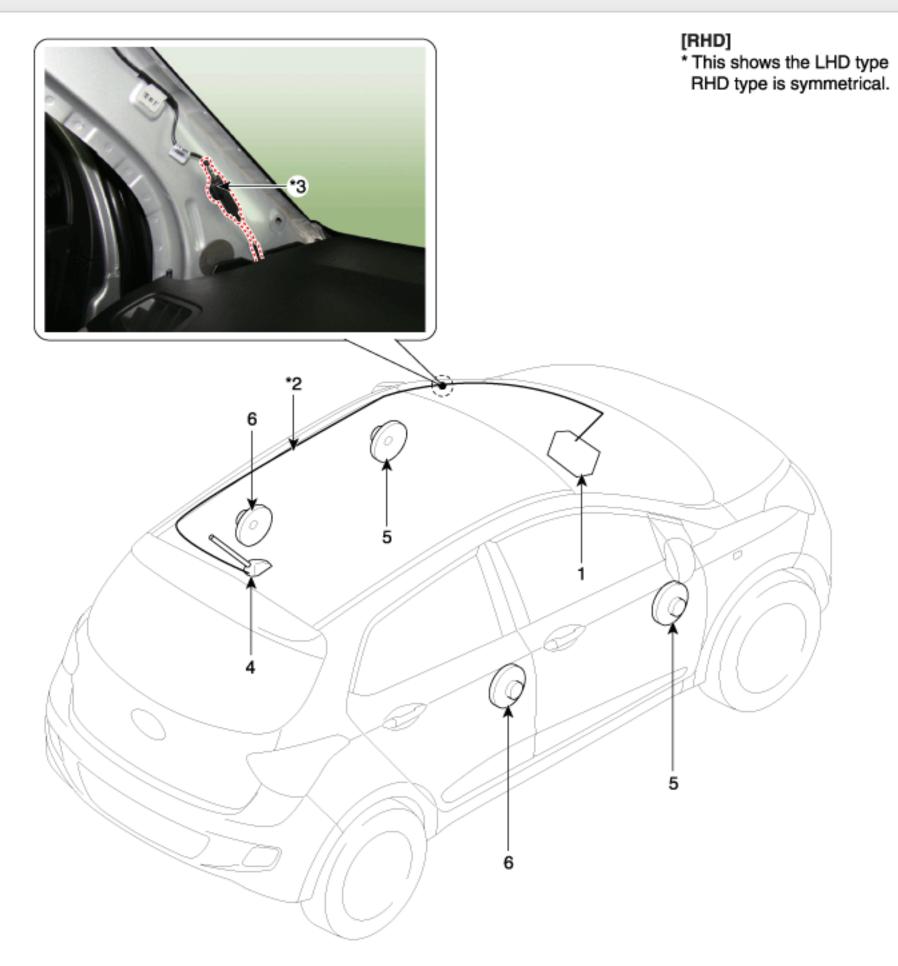
### **INSTALLATION**

- 1. Connect the connectors and cables.
- 2. Install the audio assembly.
- 3. Install the center fascia panel.
- 4. Connect the negative (-) battery terminal.

### NOTICE

Make sure the audio head unit connectors are plugged in properly and the antenna cable is connected properly.

# **COMPONENT LOCATION**



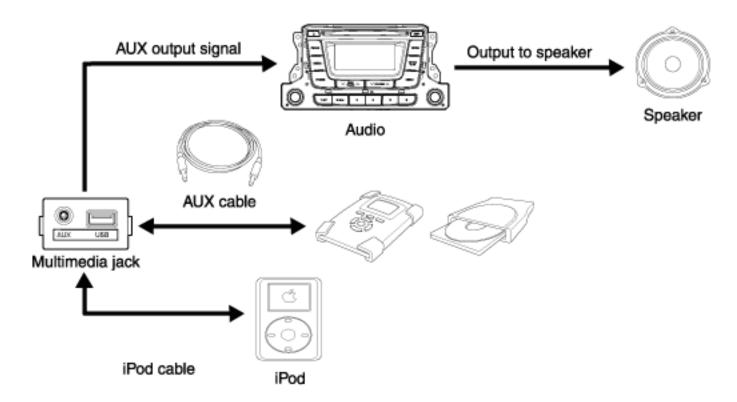
- 1. Audio unit
- 2. Tweeter speaker
- 3. Antenna cable connector
- 4. Roof antenna (Radio)

- 5. Front door speaker
- 6. Rear door speaker
- 7. Antenna feeder cable

### **DESCRIPTION**

The multimedia jack on the console upper cover is for customers who like to listen to external portable music players like the MP3, iPod and etc., through the vehicle's sound system when it is linked to this jack. The customer has this added option.

In case of distortions from media connected to the AUX source, the audio unit may not be defective but the output level of the used media does not match the specification of the AUX input.



Variable digital music players

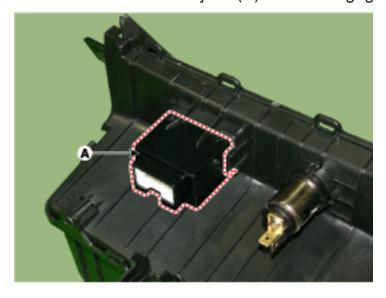


### **REMOVAL**

- Remove the front console assembly.
   (Refer to Body "Floor Console Assembly")
- 2. Remove the center facia lower tray panel (A).



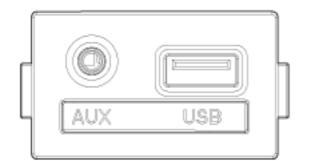
3. Remove the multimedia jack (A) after disengaging the hooks.

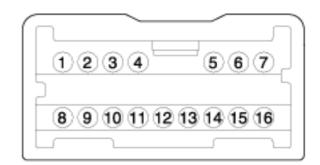


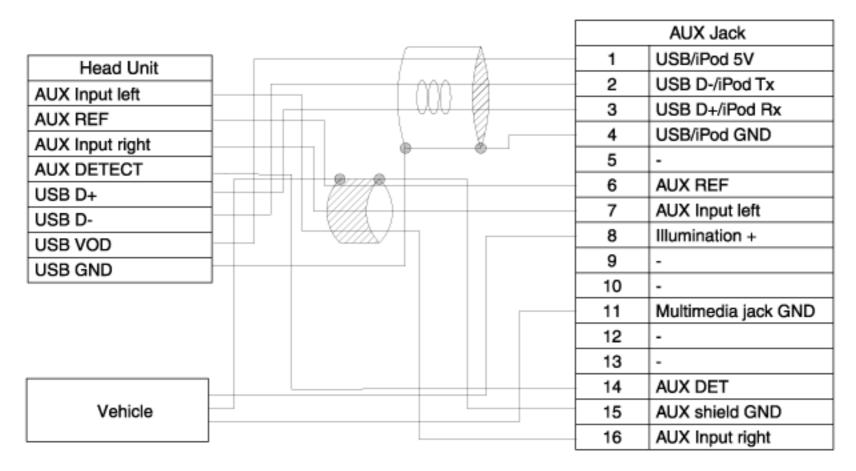
# **INSTALLATION**

- 1. Install the multimedia jack tightly.
- 2. Connect the multimedia jack connector.
- 3. Install the center facia lower tray panel and front console assembly.

### **CIRCUIT DIAGRAM**







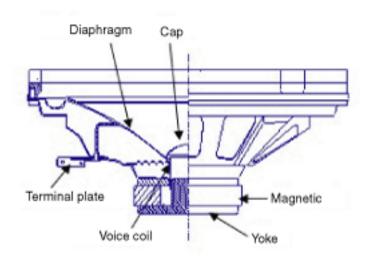
[AUX+USB]

No	Terminal Description	Condition	Specified Condition
1	USB /iPod power	USB/iPod device is inserted	4.9V ~ 5.1V
2	USB D-	USB device is inserted	3.2V ~ 3.45
3	USB D+	USB device is inserted	3.2V ~ 3.45
4	iPod detection line	iPod device is inserted	GND
5	-		
6	AUX Reference Ground	Always	Below 1 ohm
7	AUX Left Sound Signal	External Auxiliary device is Audio playing(At time of Aux jack use)	A waveform synchronized with sound is output

8	Illumination (+)		
9	-		
10	-		
11	Multimedia jack ground	Always	GND
12	-		
13	-		
14	AUX Signal Input Detect	Auxiliary device is inserted	0V(Low) → 5V(High)
15	AUX Shield Ground	Always	GND
16	AUX Right Sound Signal	External Auxiliary device is Audio playing(At time of Aux jack use)	A waveform synchronized with sound is output

# **INSPECTION**

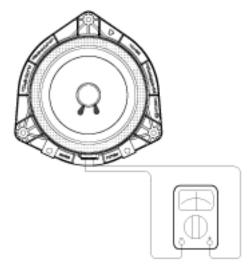
- 1. Troubleshooting for Speaker
  - (1) Basic inspection of speaker Inspect the sound from speaker after verifying that the speaker mounting screws are removed and the wiring connector is connected to remove any possible vibration transmitted from body trims and surrounding parts.



# (2) Case Troubleshooting

No.	Case	Inspection/Remedy
		Before replacing the speaker, inspect that the mounting screw is installed normally.  (Check the speaker mounting area makes rattle pushing hand.)
1	Trembling	2) If there is no rattle, remove the speaker and then check the trembling sound. After re-installing the speaker, verify that no trembling sound is heard.
	sound	a. If removed speaker make the trembling sound, replace the speaker with new one.
		b. If removed speaker make sound satisfactory fine, check the speaker mounting related part.
2 Noise		Check if the wiring connector is connected normally. If not, reconnect the wiring connector.
		2) In case of radio static, check if there is a noise from CD.
	Noise	3) If a noise is heard with the radio and CD on, replace the speaker with new one.
		NOTICE
		In case there is only radio static, this may be the cause of the poor radio reception.  Thus the speaker needs no repair and replacement.
		Inspection of the wiring connection between the battery and the speaker
		Before replacing the speaker, inspect the wiring connection between the battery and the speaker is normal.
		2) Check the supply power to the speaker and the resistance, then inspect the sound quality.
		■ Specified impedance : 4.0 ± 0.6Ω

3 Speaker in operative



3) If the speaker works poorly, replace it with new one.

# **▲** CAUTION

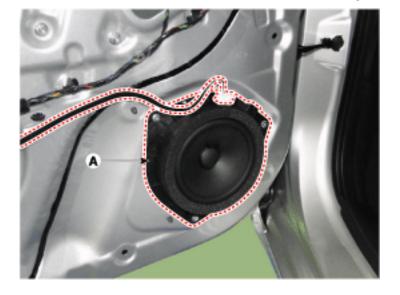
When handling the speakers:

- Do not damage the speaker with impact, like dropping or throwing it.
- Be careful not to drop water and oil on the speakers.
- Caution during handling of speaker because the material of diaphragm is paper which is easily torn by impact or external force.
- Modifying the audio system may cause damage to the speakers. If this is the case, the speakers are not covered by the manufacturer's warranty.

### **REMOVAL**

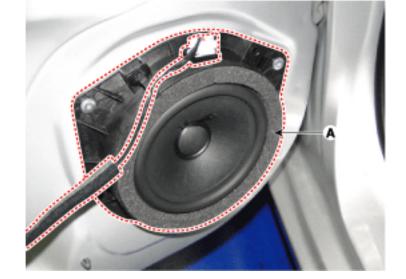
### Front Speaker

- Remove the front door trim.
   (Refer to Body "Front Door Trim")
- 2. Remove the front speaker (A) after loosening 3 rivets.



# Rear Speaker

- Remove the rear door trim.
   (Refer to Body "Rear Door Trim")
- 2. Remove the rear speaker (A) after removing 3 rivets.



# **INSTALLATION**

# Front Speaker

- 1. Install the front speaker.
- 2. Install the front door trim.

# Rear Speaker

- 1. Install the rear speaker.
- 2. Install the rear door trim.

# **SPECIFICATION**

Item	Specification
Model	RADIO/CDP/MP3(PA730)
Power supply	DC 14.4 V
Rated output	Max. 43 W x 4 : 14 V/THD 21WX4 :14V
Impedance	4 Ω x 4
Antenna	80 PF 75 Ω
Tuning type	PLL synthesized tuning
Other	Internal Amplifier

# Speaker

Item		PA730
Input Power	Front door	Nominal : 15W (Max. : 25W)
(W)	Rear door	Nominal : 15W (Max. : 25W)
Speaker impedance	Front door	Nominal : 4 ± 0.6
(Ω)	Rear door	Nominal : 4 ± 0.6

#### **INSPECTION**

In the state of IGN1 ON, when multifunction switch module detects auto light switch on, tail lamp relay output and head lamp low relay output are controlled according to auto light sensor's input.

The auto light control doesn't work if the pin sunlight supply (5V regulated power from Ignition 1 power to sunlight sensor) is in short circuit with the ground.

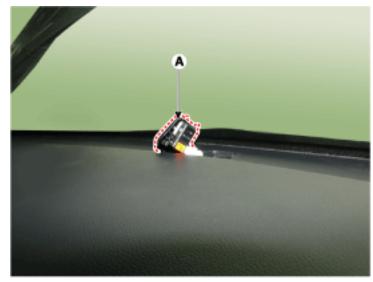
If IGN1 ON, The BCM monitors the range of this supply and raises up a failure as soon as the supply's voltage is out of range.

Then this failure occurs and as long as this is present, the head lamp must be turned on without taking care about the sunlight level provided by the sensor.

This is designed to prevent any head lamp cut off when the failure occurs during the night.

### **REMOVAL**

- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the auto light sensor (A) from crash pad upper side by using screw (-) driver.



### NOTICE

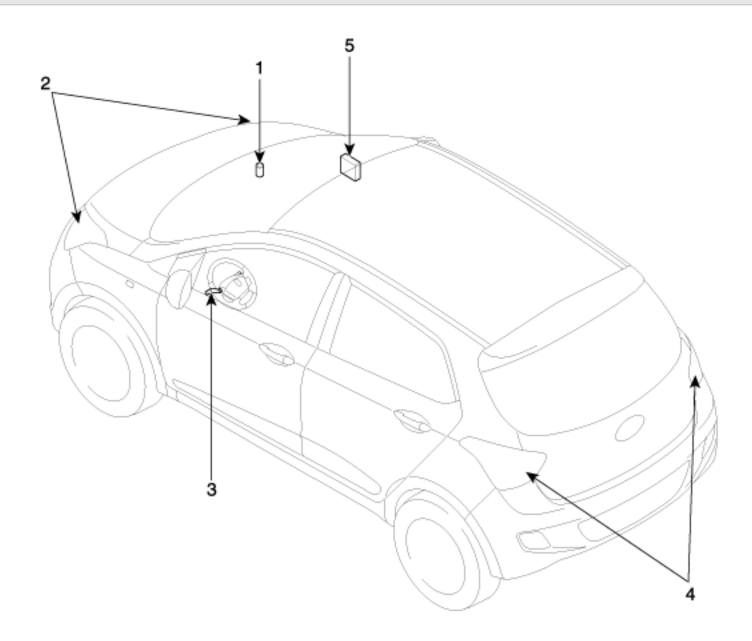
Apply the protective tapes to auto light sensor and its related parts.

3. Remove the auto light connector.

### **INSTALLATION**

- 1. Reconnect the auto light connector.
- 2. Install the auto light sensor.

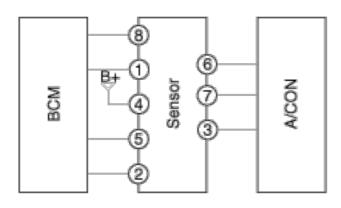
# **COMPONENT LOCATION**

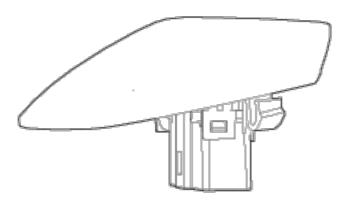


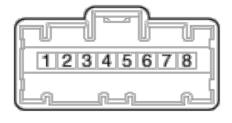
- 1. Auto light sensor (Europe option)
- 2. Head lamps
- 3. Lighting switch (Auto)

- 4. Tail lamps
- 5. Body control module (BCM)

# **CIRCUIT DIAGRAM**







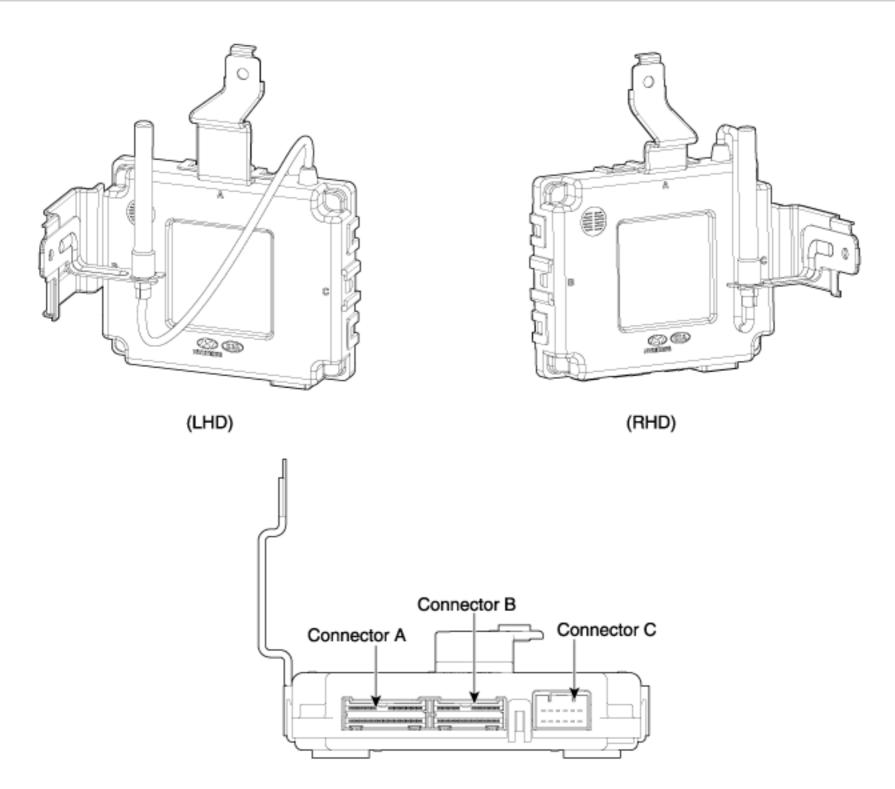
[ Auto Light Connector ]

No.	Description		
1	Auto light signal		
2	Auto light GND		
3	Photo signal (RH)		
4	LED power (B+)		
5	LED GND (To BCM)		
6	Photo signal (LH)		
7	Photo power (SW)		
8	Auto light power (5V)		

# **SPECIFICATIONS**

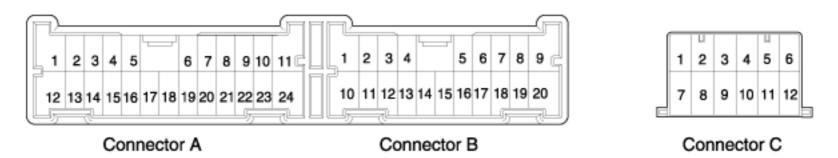
Items		Specifications
Rated voltage		5V
Load		Max. 1mA (When head lamp lighting)
Illuminations (LLIV)	50	1.42 ± 0.31V
Illuminations (LUX)	150	$3.84 \pm 0.84 \text{V}$

# **COMPONENTS**



\* Internal Buzzer : Parking assist system buzzer

#### **Pin Arrangement**



### **Connector Pin Information**

No	Connector A	Connector B	Connector C
1	B+	Side airbag option switch	Door lock relay
2	IGN 1	-	Start inhibit relay
4			

3	-	LIN (RPAS)	Tailgate unlock relay
4	-	Crash unlock input	Outside mirror unfolding
5	Inhibit R	CAN High	Outside mirror folding
6	Front fog lamp switch	CAN Low	B+ (Power)
7	Head lamp low switch		GND (Outside mirror)
8	Rear fog lamp switch	-	Door unlock relay
9	-	-	Burglar horn relay
10	-	-	-
11	RPAS OFF switch	-	-
12	-	-	-
13	IGN 2	-	
14	-	Diagnosis K	
15	ACC	-	
16	-	-	
17	Autofolding switch	PAS OFF indicator	
18	Key IN switch	-	
19	Tail lamp switch	-	
20	-	Power GND	
21	Head lamp high switch		
22	-		
23	-		
24	Signal GND		

#### **REMOVAL**

- 1. Disconnect the negative (-) battery terminal.
- Remove the glove box housing. (Refer to Body - "Glove Box Housing")
- 3. Remove the BCM unit (A) after loosening bolt and nut.



### **INSTALLATION**

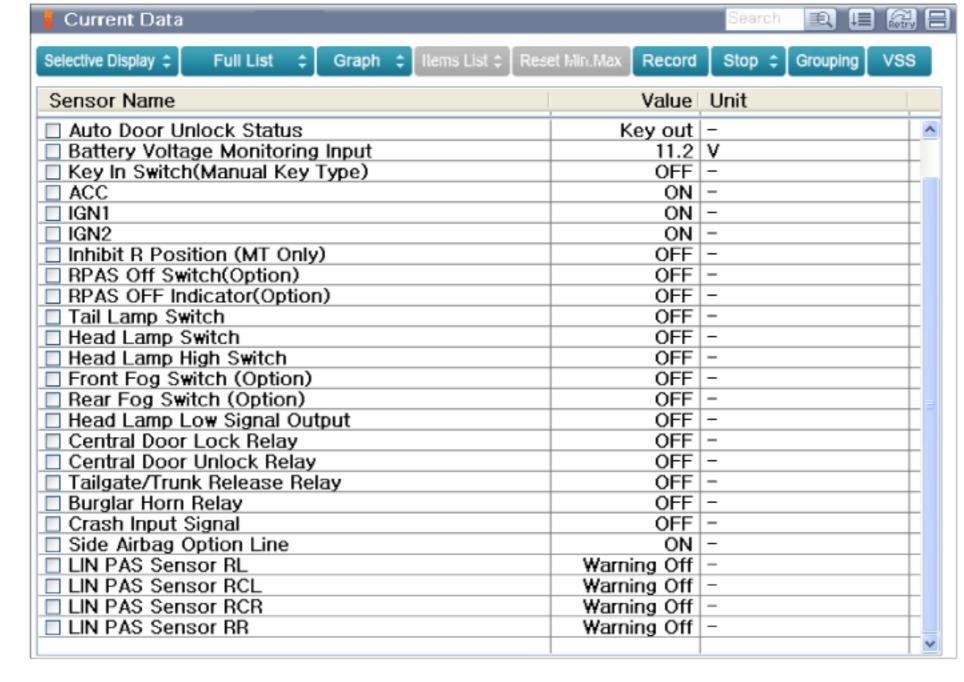
- 1. Install the BCM unit.
- 2. Install the crash pad lower panel.
- 3. Connect the negative (-) battery terminal.

#### **BCM DIAGNOSIS WITH GDS**

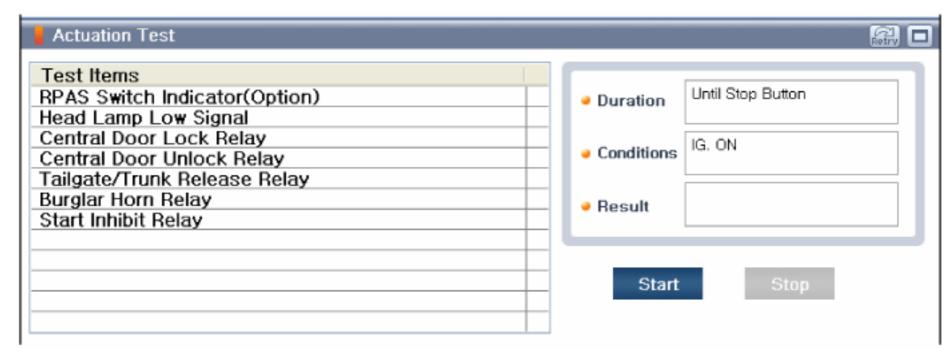


- 1. The body control module can diagnose by using the GDS more quickly.

  The BCM communicates with the GDS and then reads the input/output value and drives the actuator.
- 2. To diagnose the BCM function, select the menu of model and body control module.
- 3. Select "Input/output monitoring", if you will check current data of body network system. It provides input/output status of each module.

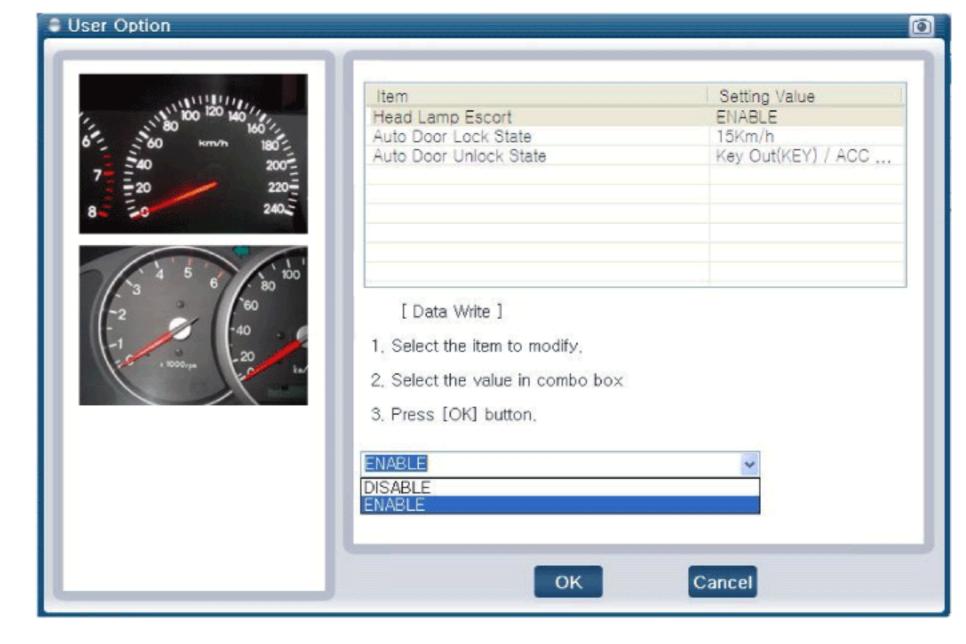


4. If you will check each module data operation forcefully, select "Actuation test".

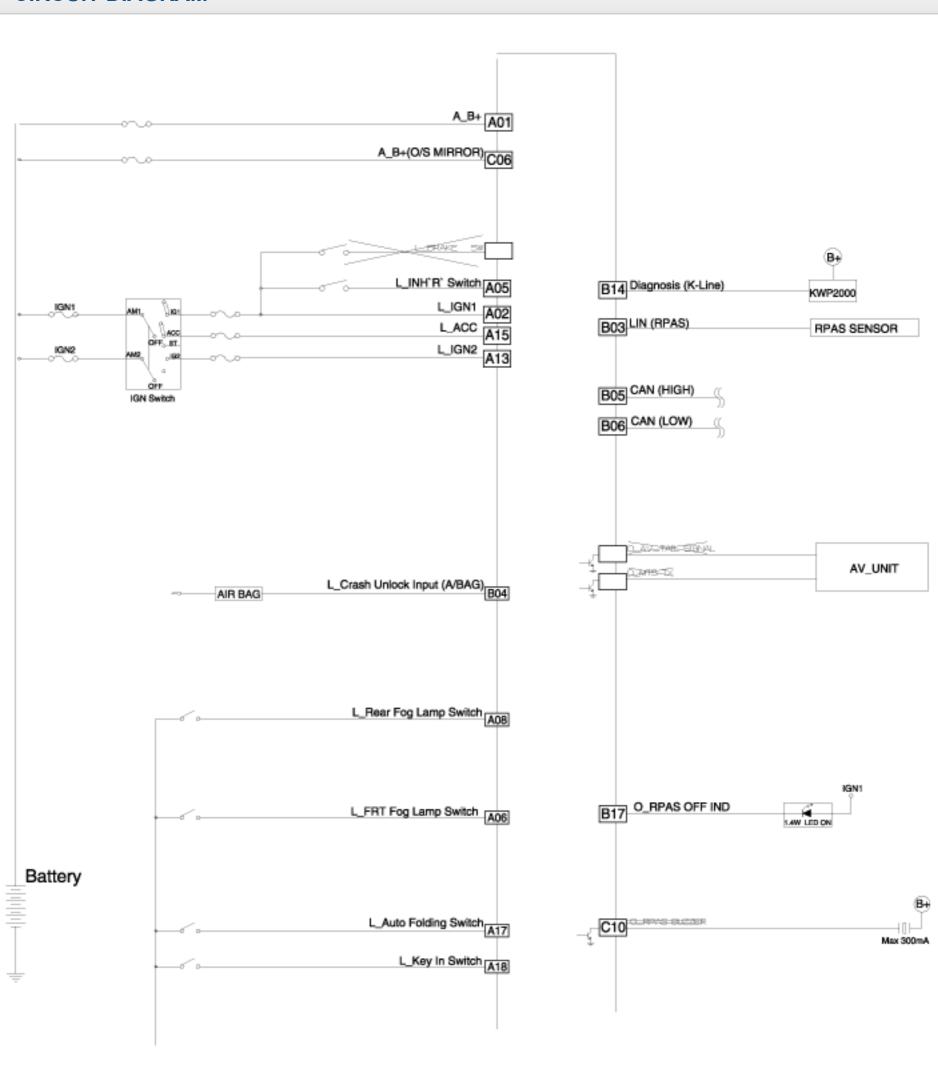


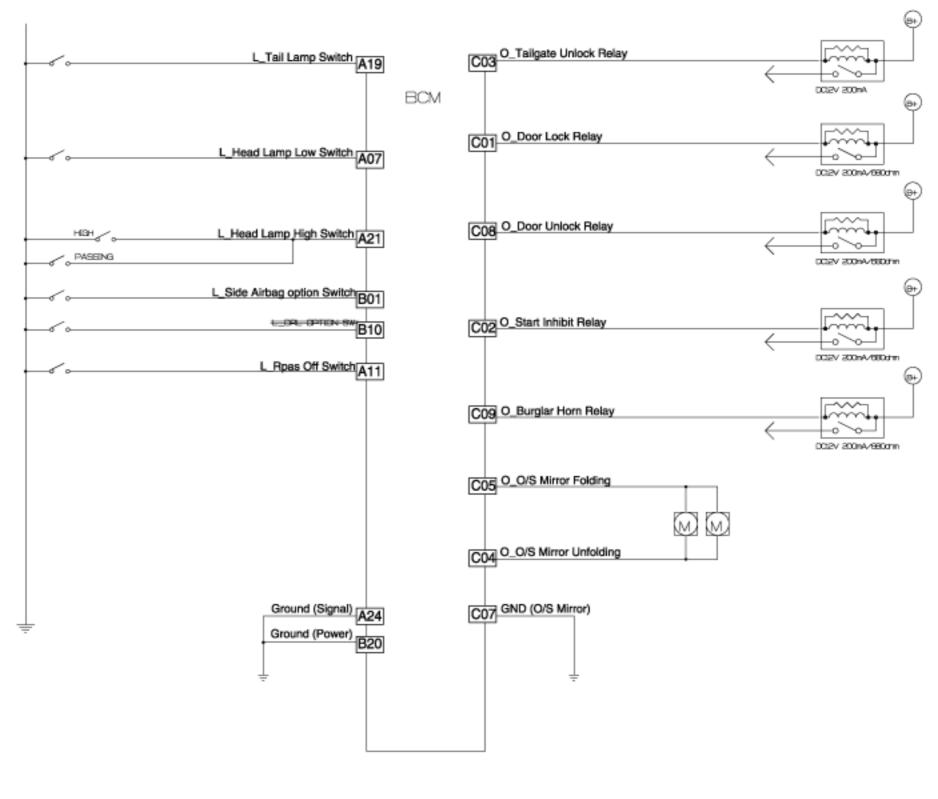
5. If you want to change user option, select "user option".





# **CIRCUIT DIAGRAM**



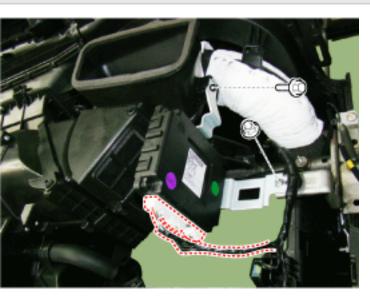


2016 > G 1.2 MPI > G 1.2 MPI > Body Electrical System > BCM (Body Control Module) > Body Control Module (BCM) > Specifications

# **SPECIFICATIONS**

Items	Specifications	
Rated voltage	DC 12V	
Operating voltage	DC 9 ~ 16V	
Operating temperature	-30°C~ 80°C (-22°F~176°F)	
Dark current	BCM & Receiver : 4mA Max BCM : 3mA Max	

# DESCRIPTION



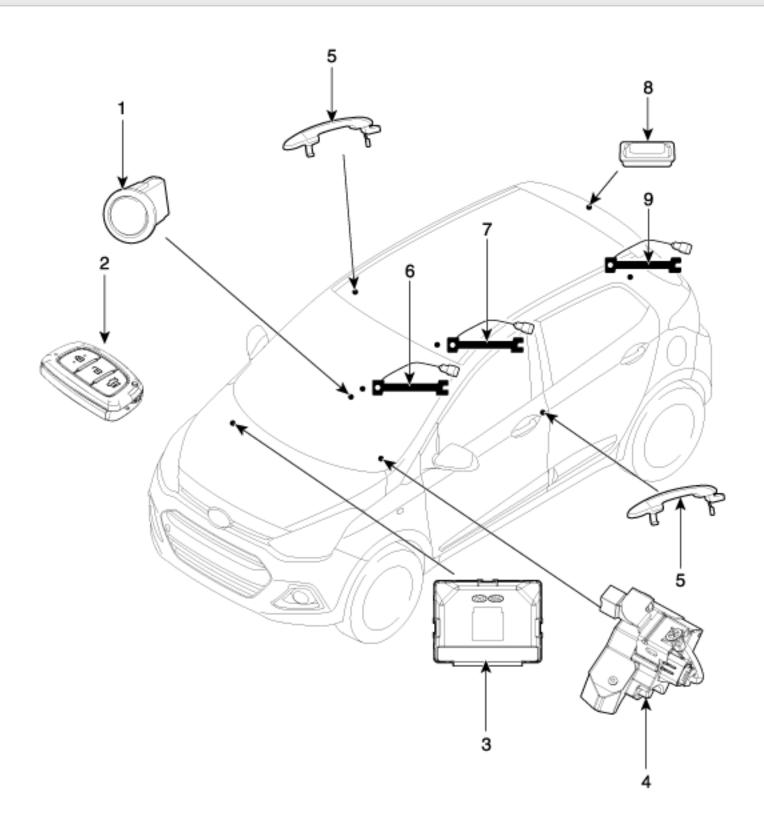
# **Function**

Function	Description		
runction	Input	Output	
	– IGN1 On,	Power Window/Safty Power Window enable all the time	
POWER WINDOW / SAFTY E POWER WINDOW	– IGN1 Off,	<ul> <li>30sec. After IGN 1 turned off, Power Window/Safty Power Window disable</li> </ul>	
	<ul> <li>less than 30 sec. after IGN1 turned off, and Drv Door Open</li> </ul>	<ul> <li>Power window/Safty Power Window disable immediately</li> </ul>	
REAR DEFOGGER	<ul> <li>IGN1 On &amp; Alternator On &amp; Defogger Sw On,</li> </ul>	<ul> <li>Defogger On for 20 min.</li> </ul>	
INTERIOR LAMP	<ul><li>– (IGN1 or ACC) Off &amp; Any door Open</li></ul>	<ul> <li>Interior Lamp On for 20min.</li> </ul>	
AUTO CUT	- All Door Close & Tx Lock	<ul> <li>Interior Lamp On for 5sec.</li> </ul>	
TAILLAMP	<ul><li>Tail lamp Sw On,</li></ul>	- Tail Lamp On	
TAIL LAMP AUTO CUT	<ul> <li>Key In &amp; Tail Sw On → Key Off → Drv</li> <li>Door Open</li> </ul>	– Tail Lamp Off	
TAIL LAIMP AUTO CUT	<ul> <li>key In &amp; Tail Sw On → Key Off → Drv</li> <li>Door Open Tail Sw Off → Tail Sw On</li> </ul>	– Tail Lamp On	
	<ul> <li>IGN1 On &amp; Autolight Sw On with day light condition</li> </ul>	<ul> <li>Tail lamp Off, Headlamp Off</li> </ul>	
	<ul> <li>IGN1 On &amp; Autolight Sw On with night light condition</li> </ul>	<ul> <li>Tail lamp On, Headlamp On</li> </ul>	
AUTOLIGHT	<ul> <li>IGN1 on &amp; Autolight Sw on with day light condition → night light condition</li> </ul>	<ul> <li>2.5sec. after sensing night light condition, Tail lamp On and Headlamp On</li> </ul>	

	<ul> <li>IGN1 on &amp; Autolight Sw on with night light condition → day light condition</li> </ul>	<ul> <li>2.5sec. after sensing day light condition, Tail lamp Off and Headlamp Off</li> </ul>		
HEADLAMP	<ul> <li>IGN2 On &amp; Headlamp Low Sw On,</li> </ul>	<ul> <li>Head Low Lamp On, Head High Lamp</li> <li>Off</li> </ul>		
TILADLAWII	<ul> <li>IGN2 On &amp; Headlamp High Sw On,</li> </ul>	Head Low Lamp Off, Head High Lamp On		
	<ul> <li>IGN2 On, HeadLamp Sw On → IGN Off,</li> </ul>	<ul> <li>Head Lamp On &amp; Tail Lamp On for 5min.</li> </ul>		
ESCORT	<ul> <li>IGN2 On, HeadLamp Sw On → IGN</li> <li>Off → Driver Door Open → Drive Door</li> <li>Close,</li> </ul>	<ul> <li>Head Lamp On for 15sec, and Tail Lamp On for 15sec.</li> </ul>		
	<ul> <li>Headlamp SW On &amp; All Door Closed &amp; All Door Locked &amp; Key Off &amp; TX Unlock ,</li> </ul>	<ul> <li>Headlamp On &amp; Tail lamp On for 15 sec.</li> </ul>		
WELCOME	<ul> <li>Headlamp SW On &amp; All Door Closed &amp; All Door Locked &amp; Key Off &amp; TX Unlock → TX Lock before 15 sec timer expirsed,</li> </ul>	<ul> <li>Headlamp Off just after TX Lock</li> </ul>		
	<ul> <li>Autolight Sw On &amp; night light condition</li> <li>&amp; All Door Closed &amp; All Door Locked &amp;</li> <li>Key Off &amp; TX Unlock ,</li> </ul>	<ul> <li>Headlamp On &amp; Tail lamp On for 15sec.</li> </ul>		
CENTRAL LOCK/UNLOCK	- P/WDW Lock Sw On or Tx Lock ,	- All Door Lock		
OLIVITAL LOCIVONLOCIC	- P/WDW Unlock Sw On or Tx Unlock ,	- All Door Unlock		
WITH KNOB	<ul><li>Driver/Assist Knob Lock</li></ul>	- All Door Lock		
LCOK/UNLOCK	<ul> <li>Driver/Assist Knob Unlock</li> </ul>	- All Door Unlock		
CRASH UNLOCK	<ul> <li>Key On &amp; Crash Signal received,</li> </ul>	<ul> <li>All Door Unlock for 5sec.</li> </ul>		
	<ul> <li>Key On &amp; Driver/Assist door Open &amp; P/WDW Lock Sw On,</li> </ul>	<ul> <li>All Door Unlock. If knob keeps being in lock, BCM retries unlock 3 times</li> </ul>		
KEY REMINDER	<ul> <li>Key On &amp; Driver/Assist Door Open &amp; Driver/Assist Knob changes unlock → lock</li> </ul>	<ul> <li>All Door Unlock. If knob keeps being in lock, BCM retries unlock 3 times</li> </ul>		
SPEED SENSING	<ul> <li>IGN1 On &amp; Alternator On &amp; Any Door Unlock &amp; Vehicle Speed &gt;15km/h,</li> </ul>	- All Door Lock		
AUTO DOOR LOCK	<ul> <li>IGN1 On &amp; Alternator On &amp; Vehicle Speed &gt;15km/h &amp; All Door Lock → Any Door unlock,</li> </ul>	- All Door Lock		
KEY OFF AUTO DOOR UNLOCK	<ul><li>Any Door Lock &amp; Key [In] → [Off]</li></ul>	- All Door Unlock		
		- Armwait for 30 sec.		
	<ul> <li>Key Off &amp; All Door Closed &amp; Tx Lock ,</li> </ul>	<ul> <li>Arm after 30 sec. without any</li> </ul>		

ANTITHEFT		interrupts
	- [Arm state] Door open without Tx unlock,	Horn activates, Hazard lamp blinks
PANIC	- Tx Panic	Horn activates, Hazard lamp blinks
RPAS WARNING	Gear Position R and RPAS Sensors detecting warning,	RPAS Warning Starting according to warning level from RPAS Sensors
INTRUSION SYSTEM	- Key Off & All Door Closed & Tx Lock,	<ul><li>Armwait for 30 sec.</li><li>Arm after 30 sec. without any interrupts</li></ul>
	[Arm state] Interior intrusion detection without Door open,	Horn activates, Hazard lamp blinks

## **COMPONENT LOCATION**



- 1. Start Stop Button(SSB)
- 2. FOB key
- 3. Smart key unit
- 4. Electronic steering column lock (ESCL)
- 5. Door handle & door antenna

- 6. Interior antenna 1
- 7. Interior antenna 2
- 8. Tailgate open switch
- 9. Bumper antenna

#### **DESCRIPTION**

### System Overview

The System offers the following features:

- Human machine interface through a 1-stage button, for terminal switching and engine start.
- Control of external relays for ACC / IGN1 / IGN2 terminal switching and STARTER, without use of mechanical ignition switch.
- Steering column locking with an ESCL device; Monitoring of the vehicle status to insure safe activation of the ESCL.
- Indication of vehicle status through LED or explicit messages on display.
- Immobilizer function by LF transponder communication between fob and start/stop button.
- Redundant architecture for high system dependability .
- Interface with Low Speed CAN vehicle communication network.
- Interface with LIN vehicle communication network depending on platform .

The RKE and SMART KEY functions are not considered part of this Button Engine Start system and are specified in separated system.

### System Main Function

- Steering column locking/unlocking with ESCL.
- Switching of ACC / IGN1 / IGN2 terminals.
- Control of the STARTER relay BAT line (high side) based on communication with EMS ECU.
- Management of the Immobilizer function.
- Management of BES warning function.

#### **Button Engine Start System**

The Button Start System allows the driver to operate the vehicle by simply pressing a button (called as SSB) instead of using a standard mechanical key. It also manages the locking and the unlocking of the steering column (called as ESCL)without any specific actions by the driver.

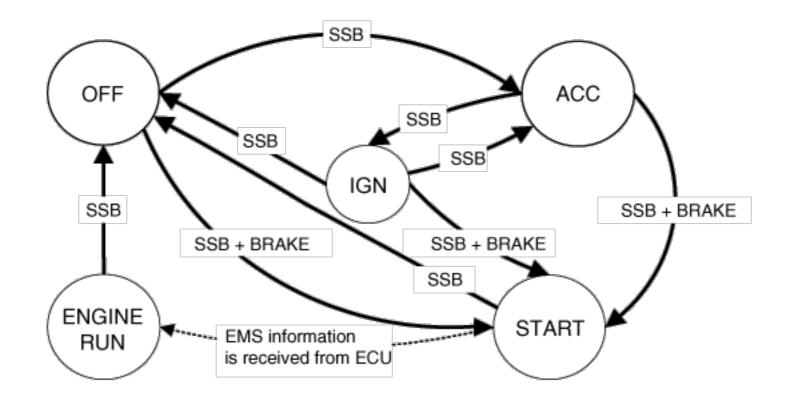
If the driver press the SSB while prerequisites on brakes, fob authentication and transmission status are satisfied, the BES System will proceed with the locking/unlocking of the steering column, the control of the terminal, and the cranking of the engine.

The driver can release the SSB as soon as this sequence initiated. After positive response from immobilizer interrogation, the system will activate the starter motor and communicate with the EMS to check the engine running status for starter release.

The driver will be able to stop the engine by a short push on the SSB if the vehicle is already in standstill. Emergency engine stop will be possible by a long press of the SSB or 3 consecutive presses in case the vehicle is in ENGINE RUNNING.

If the conditions for engine cranking are not satisfied while a push on the SSB is detected and a valid fob authenticated, the system

will unlock the steering column and switch the terminals to IGN. Another push on the SSB will be necessary to start the engine. In case of a vehicle equipped with SMART KEY system, fob authentication will not require any action from the driver. For limp home start or in case of vehicle without SMART KEY, the driver will have to push the start / stop button.



- Control Ignition and engine ON/OFF by Sending signal to IPM.
- Display status by LED Lamp ON/OFF. (Amber or Blue)

## Indicator ON/OFF Condition At Ignition Key Off Condition

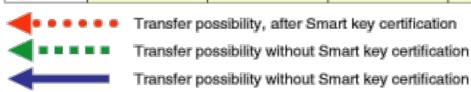
No.	Character lamp	Conditions				
1	Indicator Lamp ON	Door open, Tail lamp ON, ACC, IG ON				
2	Indicator Lamp 30sec ON → Lamp OFF	Door close, Tail lamp OFF, IG OFF				
3	Indicator Lamp OFF	Remote LOCK, Passive LOCK				
4	Rheostat at tail lamp ON (Illumination lamp)					

## Indicator ON/OFF Condition According To Ignition Key's Position

No.	Ignition conditions	Start Button LED status
1	IG OFF	LED OFF
2	IG ACC	Amber color LED ON
3	IG ON (Engine OFF)	Blue color LED ON
4	Cranking	Maintain LED status before cranking
5	Engine running	LED OFF

#### The shift of Ignition Position

	Shift Lever Position								
IGN.			P Position		N Po	sition	Other Position (D or R)		
Position	Push Brake + Push			Over 1HR	Push	Brake + Push	Push	Brake + Push	
Off									
ACC.	Ť	A CONTRACTOR			<b>Y</b> * *	1	1	<b>!</b>	
IG1 & 2	ŧ۱				ŧ1		ŧ۱	**	
Start		ı	***			***			



#### Condition of stop engine while driving

- Press 3 times button within 3 seconds.
- Press button more than 2 seconds

## Wireless Communication

Electromagnetic waves are used to exchange information between the vehicle and the FOB. Two types of RKE Key can supplement the BES system:

- Non-smart key RKE
- SMART KEY FOB

Currently the BES system comprises with SMART KEY FOB always.

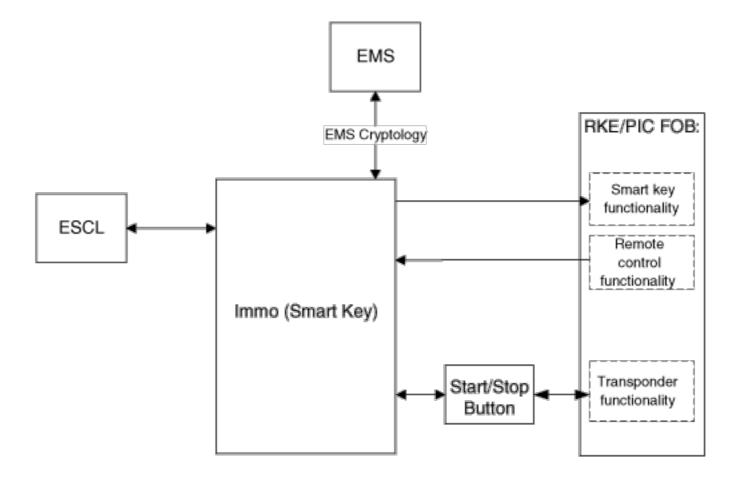
The transmitter, receiver and antennas required for the communication between the fob and the vehicle will differ depending on functionalities and regional areas.

The RKE and SMART KEY functions are in separated documents. Refer to Smart key system for more detailed information about SMART KEY function.

#### Smart Key

The SMK manages all function related to:

- "Start Stop Button (SSB) monitoring",
- "Immobilizer communication" (with Engine Management System unit for immobilizer release),
- "ESCL control",
- "Authentication server" (Validity of Transponder and in case of Smart Key option Passive Fob authentication),
- "System consistency monitoring",
- · "System diagnosis",
- · Control of display message / warning buzzer .



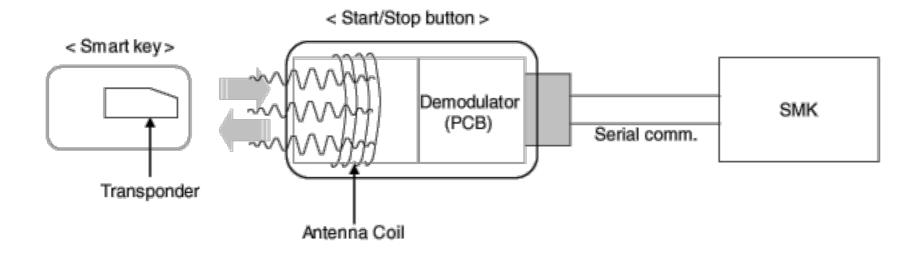
The unit behaves as Master role in the whole system.

In case of SMART KEY application, for example "Passive Access", "Passive Locking" and "Passive Authorization are integrated for ESCL/Terminal switching Operations".

It collects information about vehicle status from other modules (vehicle speed, alarm status, driver door open...), read the inputs (e.g. SSB, Lock Button and PARK position Switch), controls the outputs (e.g. exterior and interior antennas), and communicates with others devices via the CAN network as well as a single line interfaces.

The diagnosis and learning of the components of the BES System are also handled by the SMK.

#### Transponder



### Terminal And Starter Relays

Relays will be used to switch the terminals ACC / IGN1 / IGN2. Those normally-open relays will be driven by the SMK unit and located either in the passenger or engine compartment depending on the vehicle architecture.

Only one relay coil is connected to the terminal outputs of the SMK unit.

Those relays should integrate a resistor connected in parallel to the coil in order to reduce the transients during commutation.

#### Start/Stop Button(SSB)

A single stage push button is used for the driver to operate the vehicle. Pressing this button allows:

- To activate the power modes 'Off', 'Accessory', 'Ignition' and 'Start' by switching the corresponding terminals
- To start the engine
- To stop the engine

The contact will be insured by a micro-switch and a backlighting is provided to highlight the marking of the button whenever necessary.

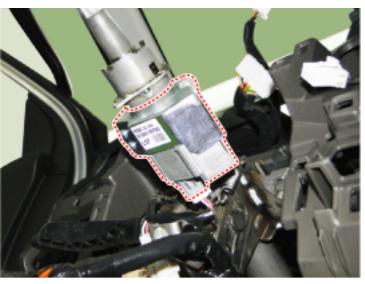
Two (2) LED colors are located in the center of the button to display of the status of the system. Another illumination LED is also integrated into the SSB for the lighting of the "Engine Start/Stop" characters.



### Electronic Steering Column Lock (ESCL)

The ESCL is needed to lock the steering column in order to prevent unauthorized usage of the vehicle. In order to achieve the required safety integrity level, the ESCL is controlled and monitored by the SMK. Such redundant architecture guarantees that the ESCL motor is supplied only during locking/unlocking operation and that it is disconnected from the battery and ground lines otherwise to avoid unexpected operation while the vehicle is in motion.

Data are exchanged between the ESCL and SMK through an encrypted serial communication interface.



**BES System State Chart** 

### System STATES in LEARNT MODE

In learnt mode, the BES System can be set in 6 different sates, depending on the status of the terminals, ESCL and Engine status:

System State	Terminal Status	ESCL Status	Engine status
1. OFF - Locked	OFF	Locked	Stopped
2. OFF - Unlocked	OFF	Unlocked	Stopped
3. ACC	ACC	Unlocked	Stopped
4. IGN	IGN1, IGN2, ACC	Unlocked	Stopped
5. Start	IGN1, Start	Unlocked	Cranking
6. IGN - Engine	IGN1, IGN2, ACC	Unlocked	Running (means "self-running")

Referring to the terminals, the system states described in the table above are same as those one found in a system based on a mechanical ignition switch. The one of distinction with Mechanical-Ignition-Switch based system is that the BES system allows specific transition from [OFF] to [START] without going through [ACC] and [IGN] states.

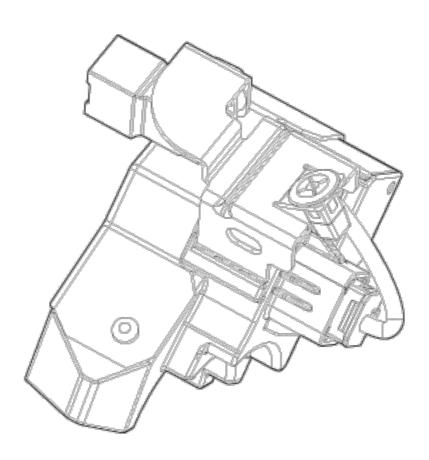
### System STATES IN VIRGIN MODE

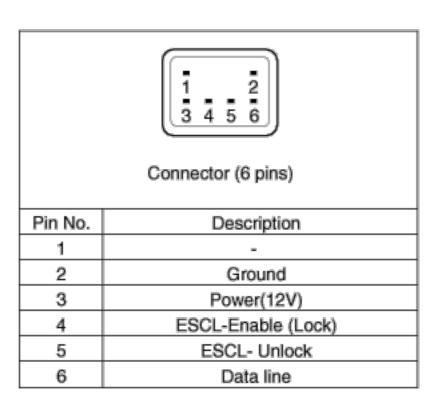
The BES System can be set in 5 different states (OFF LOCKED is not available in virgin mode), depending on the status of the terminals, ESCL and Engine status:

System State	Terminal Status	ESCL Status	Engine status
1. OFF - UNLOCKED	1. OFF - UNLOCKED OFF		Stopped
2. ACC	ACC	Unlocked	Stopped
3. IGN	IGN1, IGN2, ACC	Unlocked	Stopped
4. Start	IGN1, START with special pattern of activation see Chap 6.2.1 for details	Unlocked	Cranking
5. IGN - Engine	IGN1, IGN2, ACC	Unlocked	Running (means "self-running")

Referring to the terminals, the system states described in the table above are same as those one found in a system based on a mechanical ignition switch. The one of distinction with Mechanical-Ignition-Switch based system is that the BES system allows specific transition from [OFF] to [START] without going through [ACC] and [IGN] states.

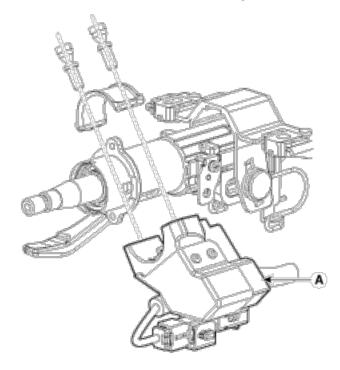
## **COMPONENT**





#### **REMOVAL**

- 1. Disconnect the negative(-) battery terminal.
- Remove the crash pad lower panel. (Refer to Body - "Crash Pad Lower Panel")
- 3. Remove the steering column upper and lower shrouds. (Refer to Body "Steering Column Shroud Panel")
- 4. Disconnect the electronic steering column lock connector (A).



Remove the electronic steering column lock. (Refer to Steering System - "Steering Column and Shaft")

### **INSTALLATION**

1. Install the electronic steering column lock (A).

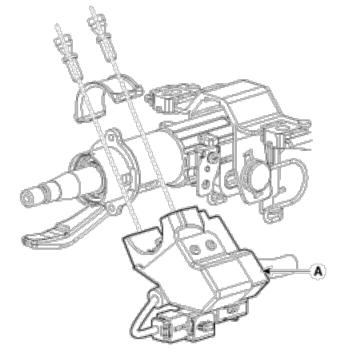
## **▲** CAUTION

Do not reuse the shear bolts.

When installing the new shear bolts to the electronic steering column lock, tighten the shear bolts until its head is cut off.

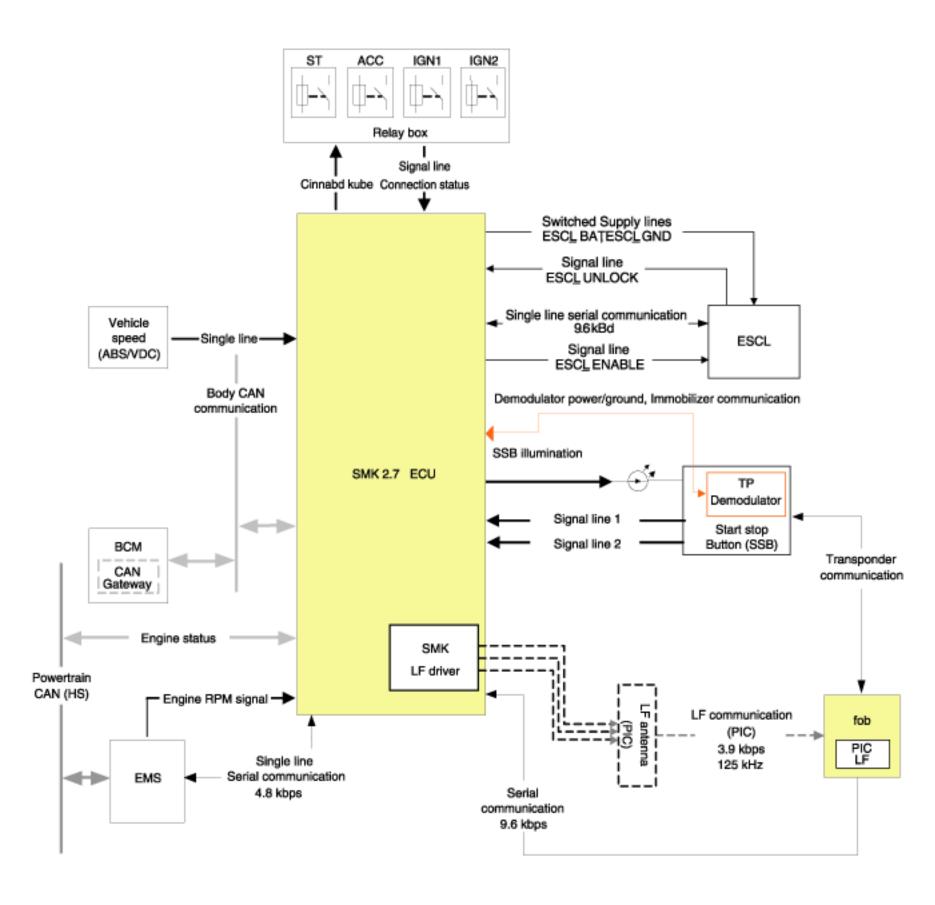
#### **Tightening torque:**

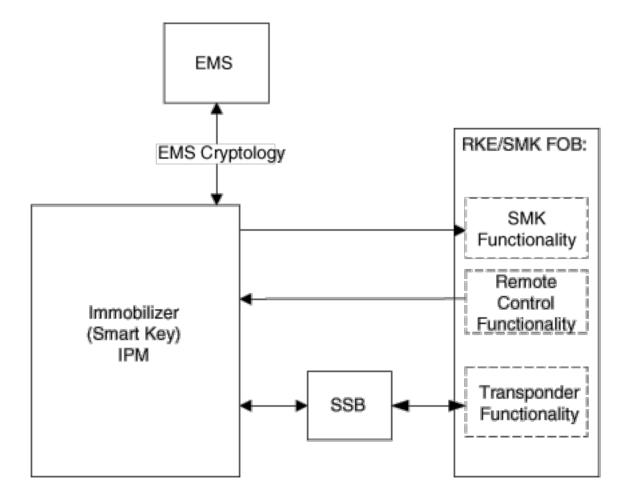
 $7 \sim 13 \text{ N.m} (0.7 \sim 1.3 \text{ kgf.m}, 5 \sim 9.4 \text{ lb.ft})$ 



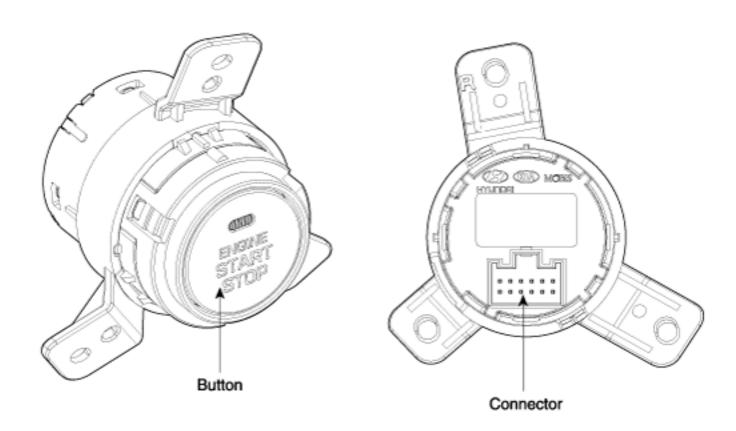
- 2. Install the steering column.
- 3. Install the crash pad lower panel.

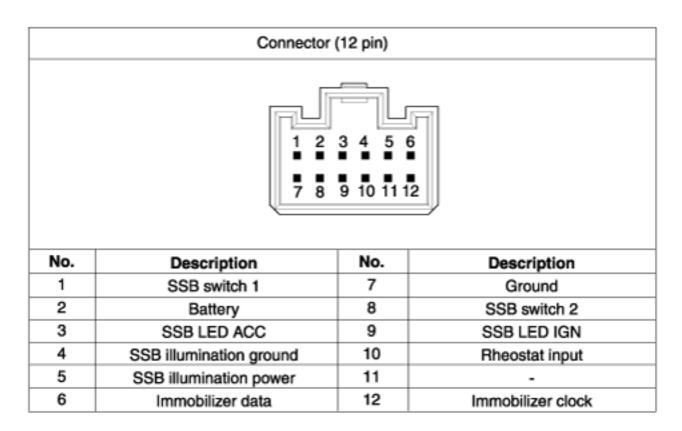
## **CIRCUIT DIAGRAM (1)**





### **COMPONENT**



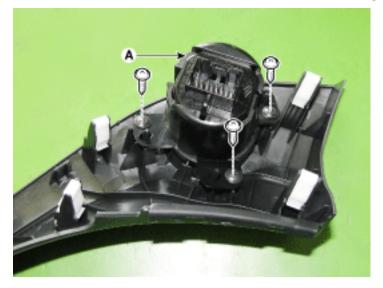


### **REMOVAL**

- 1. Disconnect the negative(-) battery terminal.
- 2. Remove the driver crash pad center garnish assembly. (Refer to Body "Center Fascia Panel")
- 3. Disconnect the start/stop button connector (B) after removing the center fascia garnish (A).



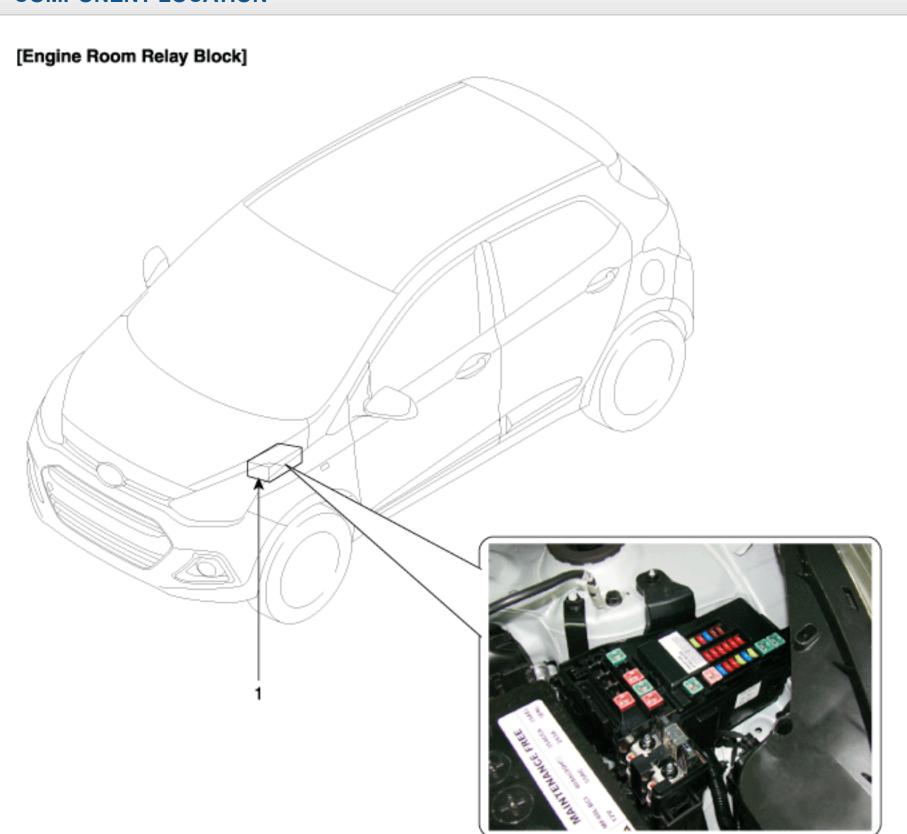
4. Remove the start/stop button (A) after removing the screws (3EA).



### **INSTALLATION**

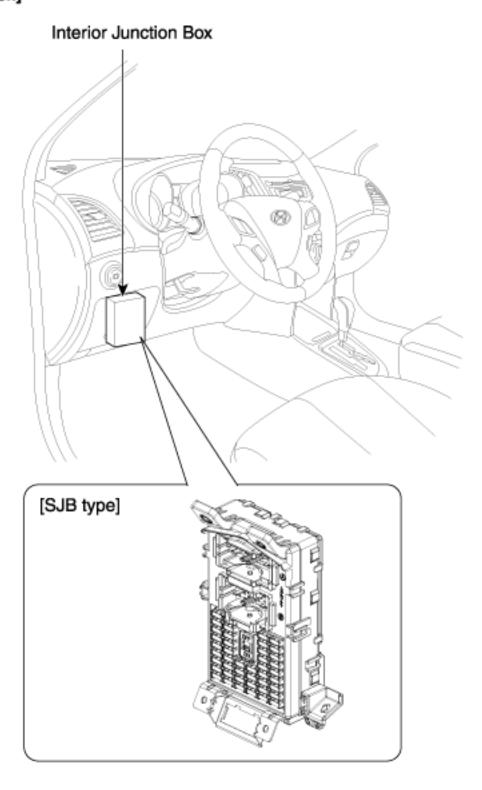
- 1. Install the start/stop button.
- 2. Install the crash pad lower panel.
- 3. Connect the negative (-) battery terminal.

## **COMPONENT LOCATION**



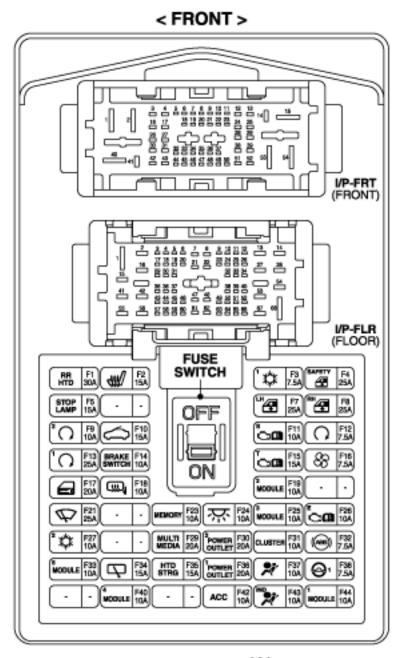
1. Engine room relay block.

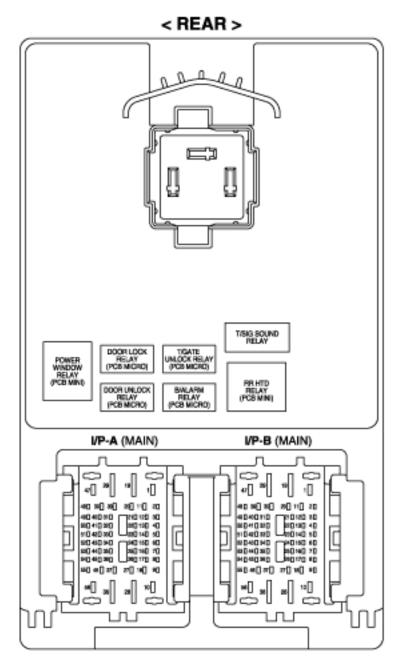
## [Interior Junction Block]



#### **COMPONENTS**

#### **Smart Junction Box**





W USE THE DESIGNATED FUSE & RELAY ONLY

#### **Smart Junction Box**

Ma	/A)	Cumbal	Euro Nome	Circuit Protected	No	/A)	Cumbal	Euro Namo	Circuit Protected
No.	(A)	Symbol	Fuse Name	Circuit Protected	No.	(A)	Symbol	Fuse Name	
F1 F2	30A 15A	RR HTD	RR HTD SHEATER	RR HTD Relay Seat Warmer LH/RH	F23	10A	MEMORY	MEMORY	Data Link Connector, Digital Clock, Instrument Cluster BCM, Tire Pressure Motoring Module, A/C Control Module Crash Door Unlock Unit, Audio, Low DC-DC Converter
F3	7.5A	1.01	A/CON 1	A/C Control Module (Auto)	F24	10A	琜	INTERIOR LAMP	Glove Box Lamp, Luggage Lamp, Room Lamp Overhead Console Lamp
F4	25A	SAFETY AT	SAFETY POWER SINDOW	Driver Safety Power Window Module	F25	10A	3 MODULE	MODULE 3	E/R Junction Box (Multipurpose Check Connector), Seat Warmer LH/RH, Console Switch, A/C Control Module, Low DC-DC Converter
F5	15A	STOP LAMP	STOP LAMP	Stop Signal Electronic Module, Data Link Connector	F26	10A	் வ	ECU	PCM, Smart Key Control Module, Alternator (G3LA/G4LA)
F7	25A	™@3	P/WDW LH	Power Window Main Switch, Driver Safety Power Window Module (LHD), Passenger Power Window Switch (RHD)	F27	10A	2.\$	A/CON 2	PCB Fuse & Relay Box (Blower Relay), A/C Control Module
F8	25A	**42	P/WDW RH	Power Window Main Switch, Driver Safety Power Window Module (RHD), Passenger Power Window Switch (LHD)	F29	20A	MULTI MEDIA	MULTI MEDIA	Auido, Low DC-DC Converter
F9	10A	'n	PDM 2	Smart Key Control Module, Start/Stop Button Switch	F30	20A	<sup>2</sup> POWER OUTLET	POWER OUTLET 2	Rear Power Outlet
F10	15A	$\Leftrightarrow$	SUNROOF	Sunroof Motor		10A	CLUSTER	CLUSTER	Instrument Cluster
F11	10A	'വമ	SENSOR	PCB Fuse & Relay Box (Vacuum Pump Relay)		7.5A	Θ	ABS	ESP Control Module
F12	7.5A	C	START	B/Alarm Relay, PCB Fuse & Relay Box (Start Relay) PCM, Smart Key Control Module Transaxie Range Switch		10A	*MODULE	MODULE 5	Head Lamp Leveling Device Switch, Sunroof Motor Head Lamp Leveling Device Actuator LH/RH Seat Warmer LH/RH
F13	25A	٠Ċ	PDM 1	Smart Key Control Module	F34	15A	42	WIPER RR	Rear Wiper Motor, Multifunction Switch
F14	10A	BRAKE SWITCH	BRAKE SWITCH	Smart Key Control Module, Stop Lamp Switch		15A	HTD STRG	HTD STRG	Steering Wheel Heater
F15	15A	™C:@	TCU	A/T ; Transaxle Range Switch, Pulse Generator 'A/'B' M/T : Vehicle Speed Sensor, PCB Fuse & Relay Box (F34)	F36	20A	1 POWER OUTLET	POWER OUTLET 1	Cigarette Lighter
F16	7.5A	88	BLOWER	PCM, A/C Control Module, Electronic A/C Compressor Blower Switch, Blower Resistor	F37	10A	27	A/BAG	SRS Control Module
F17	20A	a	DR LOCK	Door Lock/Unlock Relay, T/Gate Unlock Relay Crash Door Unlock Unit	F38	7.5A	Θ.	MDPS	MDPS Unit
F18	10A	<b>@</b>	HTD MIRR	PCM, A/C Control Module	F40	10A	4MODULE	MODULE 4	BCM, Smart Key Control Module
r 18	IUA	Can-g	HIDMINK	Driver/Passenger Power Outside Mirror Stop Lamp Switch, Tire Pressure Motoring Module	F42	10A	ACC	ACC	BCM, Smart Key Control Module, Digital Clock, Auido Low DC-DC Converter, Power Outside Mirror Switch
F19	10A	<sup>2</sup> MODULE	MODULE 2	Crash Pad Switch, Rear Parking Assist Sensor LH/RH Rear Parking Assist Sensor (Center) LH/RH	F43	10A	™ <b>≱</b> *	A/BAG IND	Instrument Cluster
F21	25A	\$	WIPER	Front Wiper Motor, Multifunction Switch	F44	10A	1 MODULE	MODULE 1	BCM, SBR Indicator, PAB Cut Off Indicator PAB Cut Off SBR Indicator

**X USE THE DESIGNATED FUSE & RELAY ONLY** 

: Leak Current Autocut Device

#### **FUSE INSPECTION**

- 1. Be sure there is no play in the fuse holders, and that the fuses are held securely.
- 2. Be sure the fuse capacities for each circuit correct.
- 3. Check whether or not the fuse is broken.

  If a fuse is to be replaced, be sure to use a new fuse of the same capacity. Always determine why the fuse blew first and completely eliminate the problem before installing a new fuse.

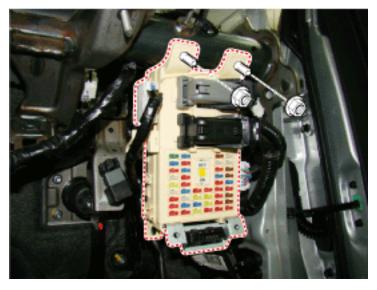
## **▲** CAUTION

The fuse with a capacity of more than normal value should not be used.

#### **REMOVAL**

### **Passenger Compartment Junction Box**

- 1. Disconnect the negative (-) battery terminal.
- Remove the crash pad lower panel. (Refer to Body - "Crash Pad Lower Panel")
- 3. Disconnect the connectors from the fuse side of the junction box.
- 4. Remove the junction box after loosening the mounting nuts.



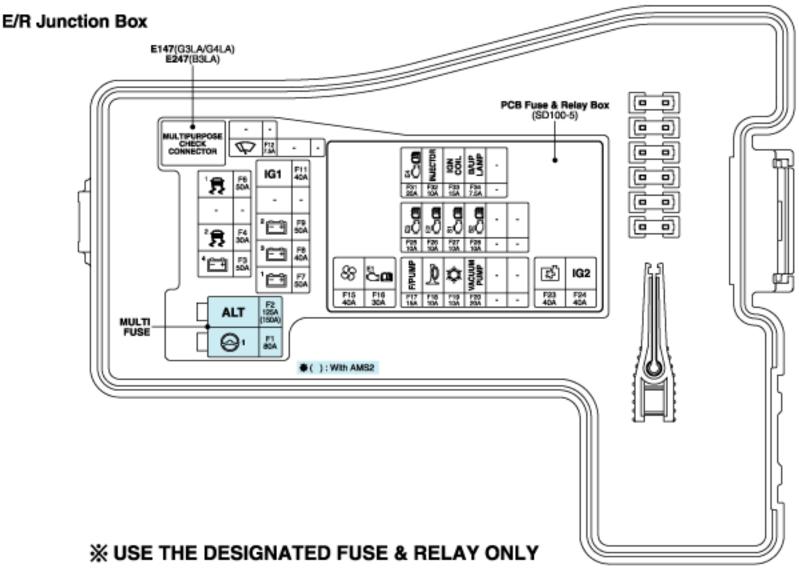
5. Disconnect the connectors from the back side of the junction box.

#### **INSTALLATION**

- 1. Install the junction box.
- 2. Install the crash pad lower panel.
- 3. Check that all system operates normally.

2016 > G 1.2 MPI > G 1.2 MPI > Body Electrical System > Fuses and Relays > Relay Box (Engine Compartment) > Components and Components Location

#### **COMPONENTS**

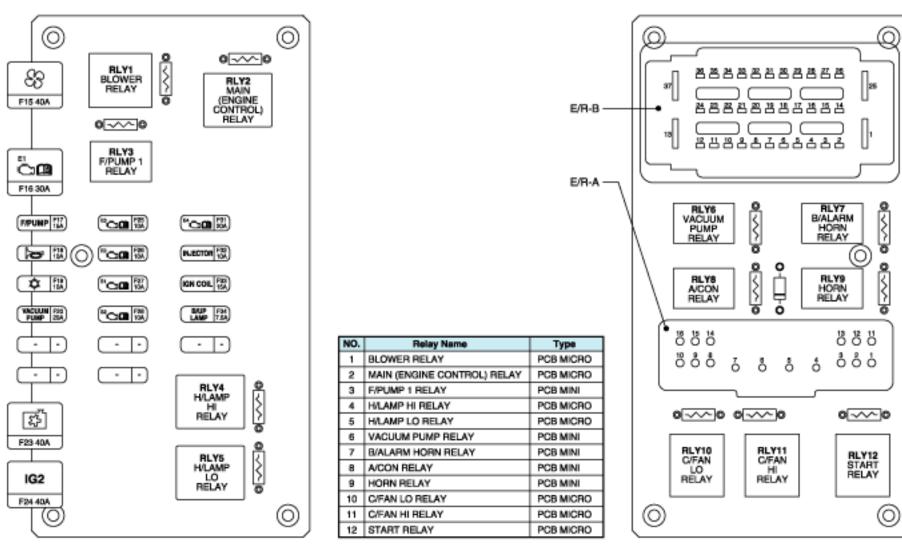


#### E/R Junction Box Circuit

E/N Jui	A Junction Box Circuit						
Fuse	No.	(A) Symbol Name		Name	Circuit Protected		
MULTI	F1	80A	⊜.	MDPS	MDPS Unit		
FUSE	F2	125A (150A)	ALT	ALT Alternator, Fuse - F3 / F4 / F6, PCB Fuse & Relay Box			
	F3	50A	1 🚞	B+4	B+4 Smart Junction Box (Fuse : F1 / F2)		
	F4	30A	° <del>§</del>	ESP 2 ESP Control Module, Multipurpose Check Connector			
	F5	-		-	-		
	F6	50A	15	ESP 1	ESP Control Module		
	F7	50A	1 🚍	B+1	Smart Junction Box (T/Sig Sound Relay, Fuse : F10, ARISU-LT1, IPS 3)		
FUSE	F8	40A	3 ==	B+3	Smart Junction Box (Power Window Relay, Fuse : F4, ARISU-LT2, IPS 5)		
	F9	50A	2 ====	B+2	Smart Junction Box (Fuse: F5 / F9 / F13 / F14 / F17, Leak Current Autocut Device Fuse: F23 / F24 / F29)		
	F10	-	-	-	•		
	F11	40A	IG1	IG1	W/O Button Start : Ignition Switch With Button Start : PDM Relay Box (IG1 / ACC Relay)		
	F12	7.5A	\$	FRT WIPER	PCM, Front Wiper Motor, Multifunction Switch		
	F13	-		-	-		
	F14	-	-	-			

**※ USE THE DESIGNATED FUSE & RELAY ONLY** 





**X USE THE DESIGNATED FUSE & RELAY ONLY** 

# PCB Fuse & Relay Box Circuit

Fuse No.	(A)	Symbol	Name	Circuit Protected		
F15	40A	88	BLOWER	Blower Relay		
F16	30A	<sup>61</sup> ⇔ <b>@</b>	ECU1	Engine Control Relay, Fuse : F25 / F26		
F17	15A	F/PUMP	F/PUMP	F/Pump 1 Relay		
F18	10A	Ð	HORN	Horn Relay, B/Alarm Horn Relay		
F19	10A	*	A/CON	A/CON Relay		
F20	20A	VACUUM PUMP	VACUUM PUMP	Vacuum Pump Relay		
F21/F22	-	-	-	-		
F23	40A	£	C/FAN	C/FAN LO Relay, C/FAN HI Relay		
F24	40A	IG2	IG2	Start Relay, Ignition Switch (W/O Button Start), PDM Relay Box (IG2 Relay) (With Button Start)		
F25	10A	° ○ <b>@</b>	ECU3	PCM		
F26	10A	" () <b>(4</b>	ECU2	B3LA: PCM, Shut Off Valve #1/#2		
F27	10A	** ○ <b>@</b>	SENSOR	C/FAN LO Relay, C/FAN HI Relay, A/CON Relay, Start Relay (G3LA, With ISG), PCM, Oil Control Valve #1/#2 (IN/EX), Purge Control Solenoid Valve, Camshaft Position Sensor #1/#2 (IN/EX)		
F28	10A	*C: <b>@</b>	SENSOR2	G3LA/G4LA: PCM		
F29/F30	-		-	-		
F31	20A	<sup>64</sup> ⇔@	ECU4	Not Used		
F32	10A	INJECTOR	INJECTOR	PCM, Immobilizer Module, F/Pump 1 Relay G3LA: Injector #1/#2/#3, G4LA: Injector #1/#2/#3/#4, B3LA: Injector #1/#2/#3 (GSL), Injector #1/#2/#3 (LPI), Crash Pad Switch		
F33	15A	IGN COIL	IGN COIL	G3LA/B3LA : Ignition Coil #1/#2/#3, Condenser G4LA : Ignition Coil		
F34	7.5A	B/UP LAMP	B/UP LAMP	A/T : PCM, Transaxle Range Switch, BCM, Instrument Cluster, Rear Combination Lamp LH/RH M/T : Back-Up Lamp Switch, Smart Junction Box (Fuse : F15)		

**\* USE THE DESIGNATED FUSE & RELAY ONLY** 

## **INSPECTION**

### **Fuse Inspection**

- 1. Be sure there is no play in the fuse holders, and that the fuses are held securely.
- 2. Are the fuse capacities for each circuit correct?
- 3. Are there any blown fuses?

  If a fuse is to be replaced, be sure to use a new fuse of the same capacity. Always determine why the fuse blew first and completely eliminate the problem before installing a new fuse.

#### **GENERAL TROUBLESHOOTING INFORMATION**

### Before Troubleshooting

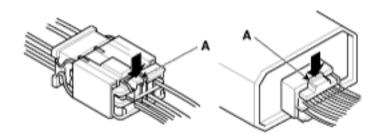
- 1. Check applicable fuses in the appropriate fuse/relay box.
- 2. Check the battery for damage, state of charge, and clean and tight connections. (Refer to Engine Electrical System "Battery")

#### NOTICE

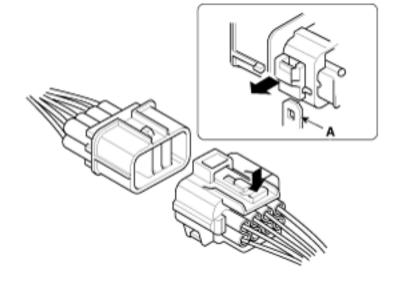
- Do not quick-charge a battery unless the battery ground cable has been disconnected, otherwise you will damage the alternator diodes.
- Do not attempt to crank the engine with the battery ground cable loosely connected or you will severely damage the wiring.
- 3. Check the alternator belt tension.

#### **Handling Connectors**

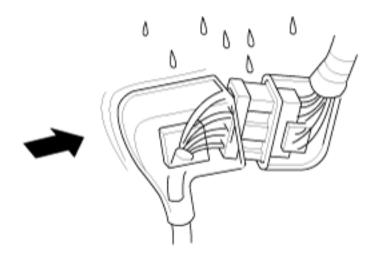
- 1. Make sure the connectors are clean and have no loose wire terminals.
- 2. Make sure multiple cavity connectors are packed with grease (except watertight connectors).
- 3. All connectors have push-down release type locks (A).



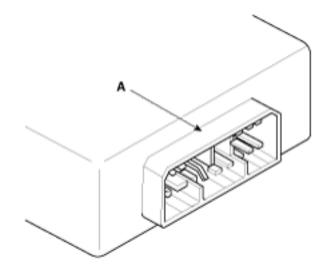
- 4. Some connectors have a clip on their side used to attach them to a mount bracket on the body or on another component. This clip has a pull type lock.
- 5. Some mounted connectors cannot be disconnected unless you first release the lock and remove the connector from its mount bracket (A).



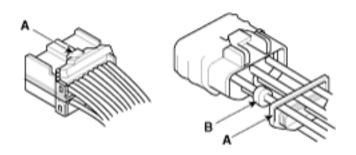
- 6. Never try to disconnect connectors by pulling on their wires; pull on the connector halves instead.
- 7. Always reinstall plastic covers.



8. Before connecting connectors, make sure the terminals (A) are in place and not bent.

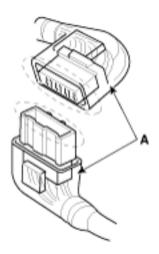


9. Check for loose retainer (A) and rubber seals (B).

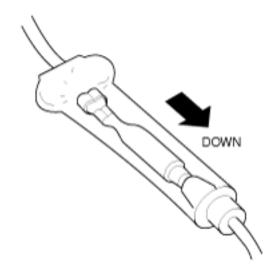


10. The backs of some connectors are packed with grease. Add grease if necessary. If the grease (A) is contaminated,

replace it.

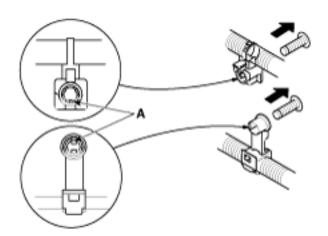


- 11. Insert the connector all the way and make sure it is securely locked.
- 12. Position wires so that the open end of the cover faces down.

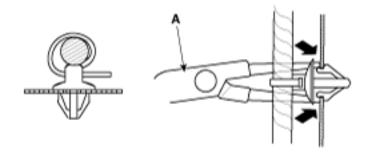


## **Handling Wires And Harnesses**

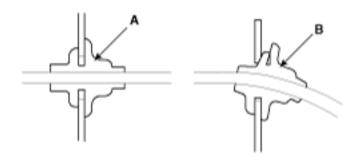
- 1. Secure wires and wire harnesses to the frame with their respective wire ties at the designated locations.
- 2. Remove clips carefully; don't damage their locks (A).



3. Slip pliers (A) under the clip base and through the hole at an angle, and then squeeze the expansion tabs to release the clip.

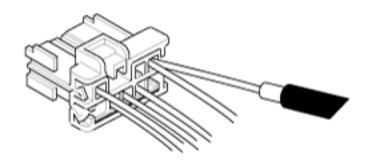


- 4. After installing harness clips, make sure the harness doesn't interfere with any moving parts.
- 5. Keep wire harnesses away from exhaust pipes and other hot parts, from sharp edges of brackets and holes, and from exposed screws and bolts.
- 6. Seat grommets in their grooves properly (A). Do not leave grommets distorted (B).

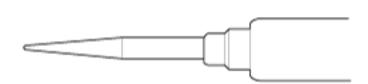


## **Testing And Repairs**

- Do not use wires or harnesses with broken insulation.
   Replace them or repair them by wrapping the break with electrical tape.
- 2. After installing parts, make sure that no wires are pinched under them.
- 3. When using electrical test equipment, follow the manufacturer's instructions and those described in this manual.
- 4. If possible, insert the remover tool from the wire side (except waterproof connector).



5. Use a remover tool with a tapered tip.



Refer to the user's guide in the wiring repair kit II (Pub. No.: 0K000 003 A05)

### Five-step Troubleshooting

- 1. Verify the complaint
  - Turn on all the components in the problem circuit to verify the customer complaint. Note the symptoms. Do not begin disassembly or testing until you have narrowed down the problem area.
- 2. Analyze the schematic
  - Look up the schematic for the problem circuit.
  - Determine how the circuit is supposed to work by tracing the current paths from the power feed through the circuit components to ground. If several circuits fail at the same time, the fuse or ground is a likely cause.
  - Based on the symptoms and your understanding of the circuit operation, identify one or more possible causes of the problem.
- 3. Isolate the problem by testing the circuit.
  - Make circuit tests to check the diagnosis you made in step 2. Keep in mind that a logical, simple procedure is the key to efficient troubleshooting.
  - Test for the most likely cause of failure first. Try to make tests at points that are easily accessible.
- 4. Fix the problem
  - Once the specific problem is identified, make the repair. Be sure to use proper tools and safe procedures.
- 5. Make sure the circuit works
  - Turn on all components in the repaired circuit in all modes to make sure you've fixed the entire problem. If the problem was a blown fuse, be sure to test all of the circuits on the fuse. Make sure no new problems turn up and the original problem does not recur.

#### **Battery Reset**

Trip computer

#### **Description**

When reconnecting the battery cable after disconnecting, recharging battery after discharged or installing the memory fuse located on the driver's side panel after removing, be sure to reset systems mentioned in the below table.

In addition, when replacing or reinstalling their fuses after removing, they should be reset according to the below table. Please refer to the below table when servicing.

System	Resetting
Power window	<ul> <li>Whenever the window cannot be properly closed or opened. Whenever the battery is discharged or the related fuse is replaced or reinstalled, reset the power window system according to the procedure below.</li> <li>1. Turn the ignition switch to the ON position.</li> <li>2. Push up the power window switch until the window glass is entirely down and then push up continuously for about 2 sec.</li> </ul>
Trip computer	When the battery is disconnected and reconnected, the set functions of the trip computer

become initialized. So, you need to explain this information to the customer.

Clock	When the battery is disconnected and reconnected, the clock becomes initialized. So, the clock should be reset. (Refer to the owner's manual)
Audio	When the battery is disconnected and reconnected, the customer's radio stations become initialized. So, you need to record the customer's radio stations prior to service, and after service, set the customer's radio stations into the audio.

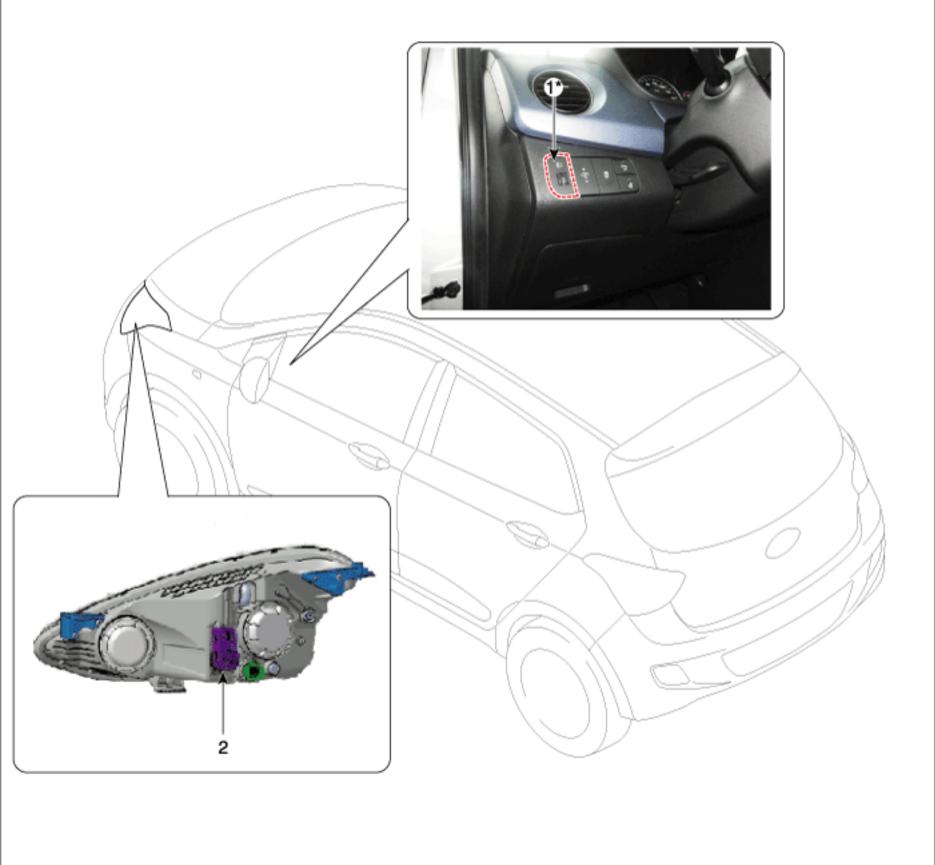
2016 > G 1.2 MPI > G 1.2 MPI > Body Electrical System > General Information > Special Service Tools

# **SPECIAL SERVICE TOOLS**

Tool (Number and Name)	Illustration	Application
RKE Battery Checker (09954-2P100)		Measuring the RKE battery voltage

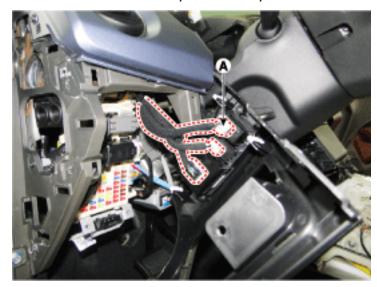
### **COMPONENT LOCATION**

The parts with asterisk (\*): This illustration shows the LHD type. RHD type is symmetrical.

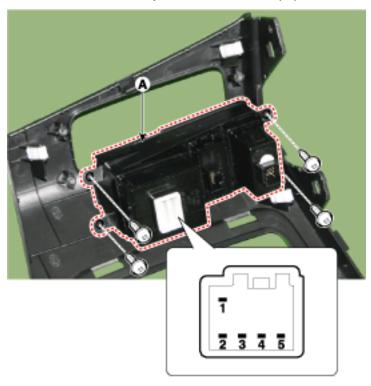


## **INSPECTION**

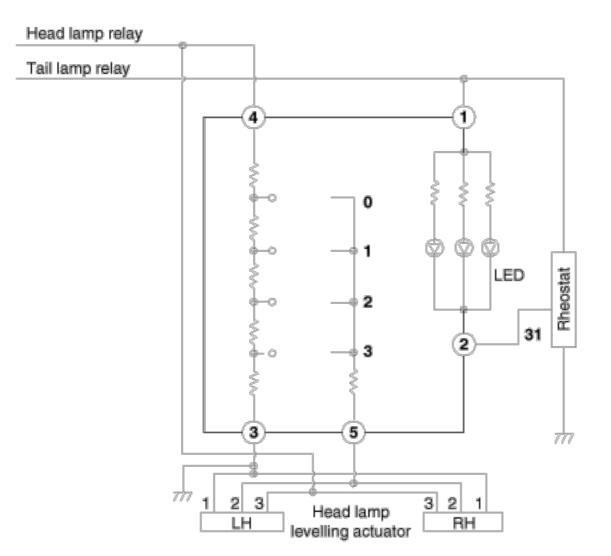
- 1. Disconnect the negative (-) battery terminal.
- Remove the crash pad lower panel. (Refer to Body - "Crash Pad Lower Panel")
- 3. Disconnect the crash pad lower panel switch connector (A).



4. Remove the crash pad side switch (A) after loosening the screws.



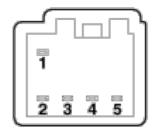
## **CIRCUIT DIAGRAM**



#### PIN CONNECTION

PIN NO	Description	
1	Illumination(+)	
2	Rheostat	
3	Ground	
4	IGN	
5	Actuator (+)	

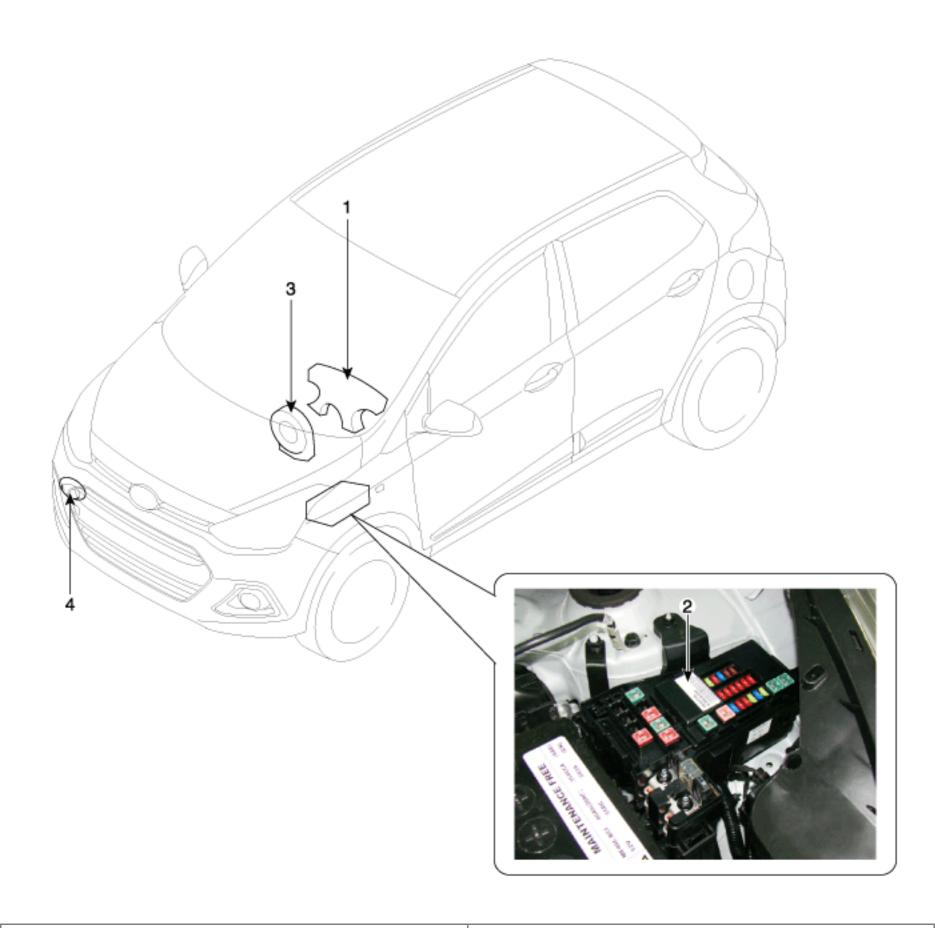
Head lamp leveling SW connector



Head lamp leveling actuator connector



# **COMPONENT LOCATION**



- 1. Horn switch
- 2. Horn relay (Engine room PCB Fuse & Relay Box)
- 3. Clock spring
- 4. Horn

#### **INSPECTION**

Test the horn by connecting battery voltage to the 1 terminal and ground the 2 terminal.

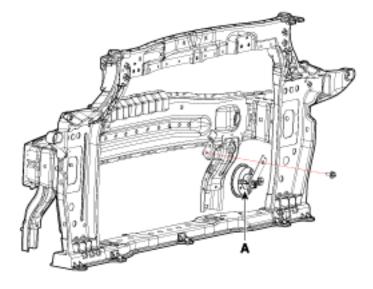
The horn should make a sound. If the horn fails to make a sound, replace it.

## **Horn Relay Inspection**

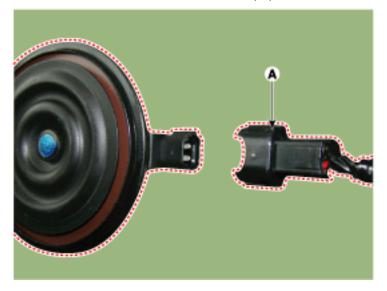
1. Horn relay is installed on the PCB fuse & relay box in the engine room box. This PCB relay is needed to replace with the PCB fuse & relay box assembly only.

#### **REMOVAL**

- 1. Disconnect the negative (-) battery terminal.
- Remove the front bumper cover. (Refer to Body - "Front Bumper Cover")
- 3. Remove the mounting bolt and disconnect the horn connector, then remove the horn (A).



4. Disconnect the horn connector (A).

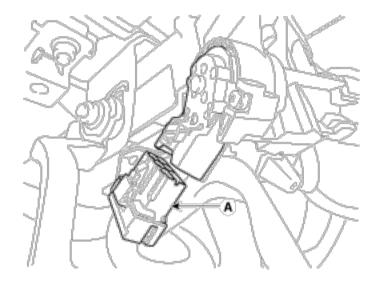


#### **INSTALLATION**

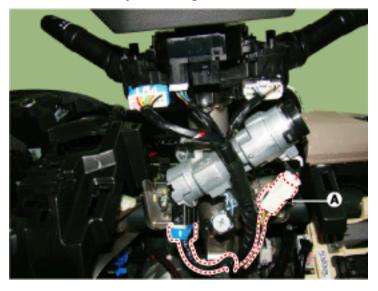
- 1. Connect the horn connector, then reassemble the horn.
- 2. Reassemble the front bumper cover.

### **REMOVAL**

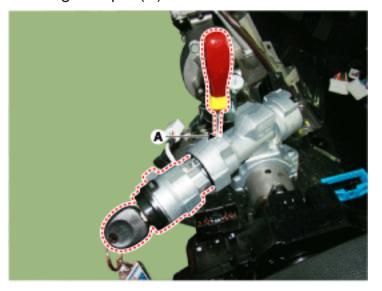
- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the driver crash pad lower panel. (Refer to Body - "Crash Pad Lower Panel")
- 3. Remove the steering column upper and lower shroud panel. (Refer to Body - "Steering Column Shroud Panel")
- 4. Remove the wiper switch. (Refer to Multifunction Switch - "Multifunction Switch")
- 5. Remove the ignition switch after disconnecting the ignition switch 6P connector (A).



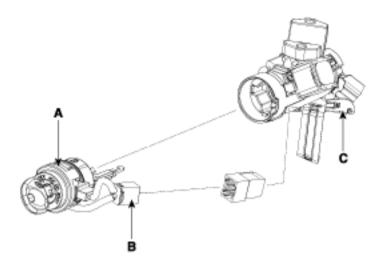
6. Remove the key warning/immobilizer connector (A).



- 7. Insert key and turn it to ACC position.
- 8. Pushing lock pin (A) with the awl.



- 9. Remove the key lock cylinder (A).
  - B : Key warning switch
  - C : Ignition switch connector

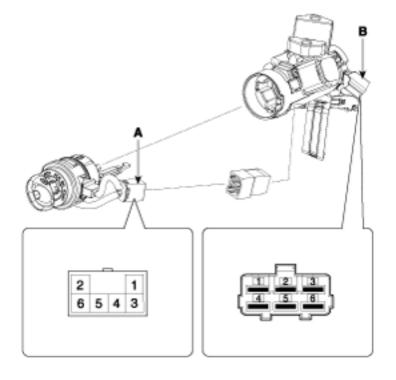


### **INSTALLATION**

- 1. Install the key lock cylinder.
- 2. Install the key warning switch.
- 3. Install the key warning/immobilizer connector.
- 4. Connect the ignition switch connector after Install the ignition switch.
- 5. Install the wiper switch.
- 6. Install the steering column shrouds.
- 7. Install the driver crash pad lower panel.

### **INSPECTION**

1. Disconnect the ignition switch connector (B) and key warning switch connector (A) from the steering column.

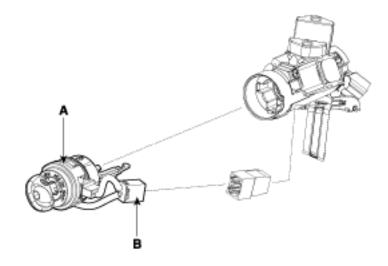


- 2. Check for continuity between the terminals.
- 3. If continuity is not specified, replace the switch.

	Terminal	Ignition switch (B)				Key wa switch	arning n (A)		
Position	Key	5	6	4	1	2	3	3	4
LOCK	Removal								
LOCK									
ACC	Insert	0-							
ON		0-	<u> </u>	— o	0-	—			
START		0		—o	0-		—		

## **REMOVAL**

- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the steering column shroud panel. (Refer to Body "Crash Pad Lower Panel")
- 3. Disconnect the connector (B) of the coil antenna and then remove the coil antenna (A) after loosening the screw.



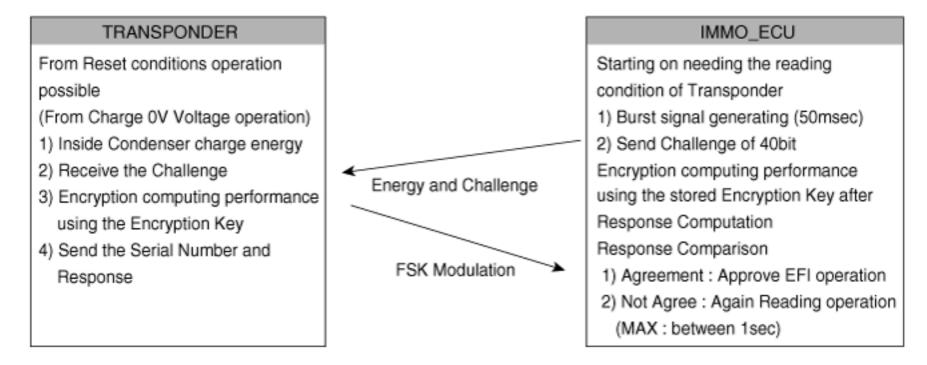
## **INSTALLATION**

- 1. Install the coil antenna and connect the connector.
- 2. Install the steering column shroud panel.

#### **DESCRIPTION**

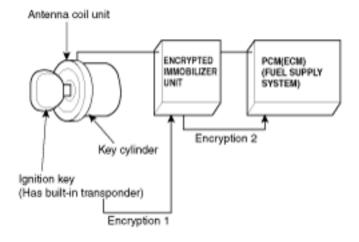
The immobilizer system will disable the vehicle unless the proper ignition key is used, in addition to the currently available anti-theft systems such as car alarms, the immobilizer system aims to drastically reduce the rate of auto theft.

1. Transponder (TP) – IMMO ECU Communication

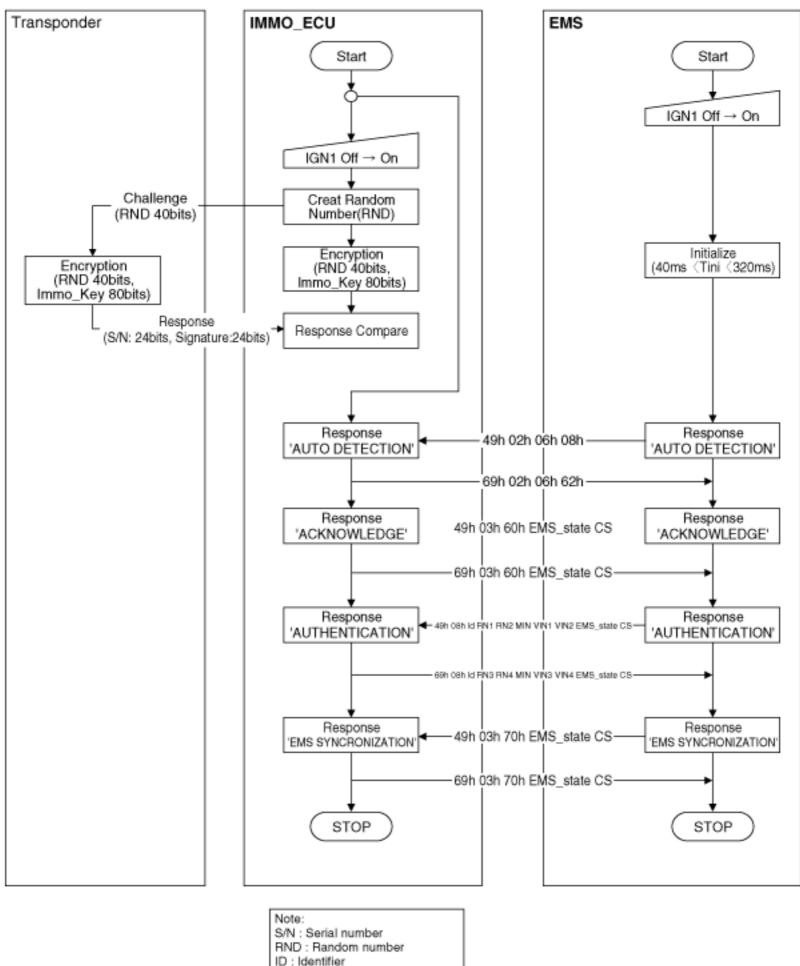


#### **TP Read Protocol**

- (1) IMMO\_ECU after IGN on (or CPU Reset cancellation) is sent Challenge to TP and confirmed Serial Number and Signature.
- (2) When response of input transponder is not correct, input is retry.
- (3) When response of input transponder is correct, The data that calculate Encryption operation in the EEPROM program compared with received data from TP.
  When Codes is same, input is finished.
  If the codes are not same, input are continued until when codes are same.
- (4) If IMMO\_ECU EEPROM code is not programming, when correct transponder is inputted (CRC Check OK), input is finished.
- (5) After IGN1 on (CPU Reset cancellation), IMMO\_ECU is reading the maximum 5times Transponder Code
- (6) In the IGN1 ON&EMS state=Lock state, when received ANKNOWLEDGE, TP is re-authenticated



2. Transponder / IMMO ECU / EMS authentication

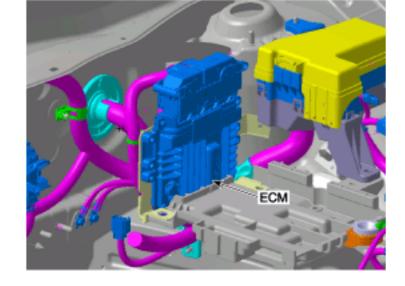


ID : Identifier

#### **COMPONENTS OPERATIONS**

#### PCM (Power Train Control Module)

- 1. The PCM (ECM) (A) carries out a check of the ignition key using a special encryption algorithm, which is programmed into the transponder as well as the PCM (ECM) simultaneously. Only if the results are equal, the engine can be started. The data of all transponders, which are valid for the vehicle, are stored in the PCM (ECM).
  - ERN (Encrypted Randorm Number) value between EMS and encrypted smartra unit is checked and the validity of coded key is decided by EMS.

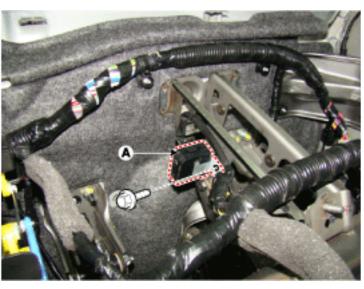


## **ENCRYPTED IMMOBILIZER unit (A)**

The IMMOBILIZER carries out communication with the built-in transponder in the ignition key. This wireless communication runs on RF (Radio frequency of 125 kHz). The IMMOBILIZER is mounted behind of the crash pad close to center cross bar.

The RF signal from the transponder, received by the antenna coil, is converted into messages for serial communication by the IMMOBILIZER device. And, the received messages from the PCM(ECM) are converted into an RF signal, which is transmitted to the transponder by the antenna.

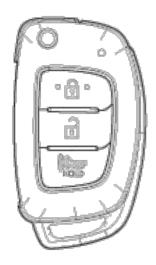
The IMMOBILIZER does not carry out the validity check of the transponder or the calculation of encryption algorithm. This device is only an advanced interface, which converts the RF data flow of the transponder into serial communication to the PCM (ECM) and vice versa.



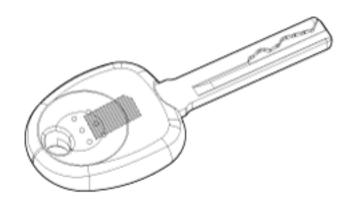
## Transponder (Built-in keys)

The transponder has an advanced encryption algorithm. During the key teaching procedure, the transponder will be programmed with vehicle specific data. The vehicle specific data are written into the transponder memory. The write procedure is once only; therefore, the contents of the transponder can never be modified or changed.

#### [Master Folding Key]



#### [Assistant Master Key]



### **Antenna Coil**

The antenna coil (A) has the following functions.

- The antenna coil supplies energy to the transponder.
- The antenna coil receives signal from the transponder.
- The antenna coil sends transponder signal to the IMMOBILIZER.
   It is located directly in front of the steering handle lock.



## **REMOVAL**

- 1. Disconnect the negative (-) battery terminal.
- Remove the crash pad lower panel.(Refer to Body "Crash Pad Lower Panel")
- 3. Disconnect the connector of the immobilizer unit and then remove the immobilizer unit (A) after loosening a nut and a bolt.



## **INSTALLATION**

- 1. Install the immobilizer control unit after connecting the unit connector.
- 2. Install the crash pad lower panel.

#### **TEACHING PROCEDURES**

#### 1. Key Teaching Procedure

Key teaching must be done after replacing a defective PCM (ECM) or when providing additional keys to the vehicle owner. The procedure starts with an PCM (ECM) request for vehicle specific data (PIN code: 6digits) from the tester. The "virgin" PCM (ECM) stores the vehicle specific data and the key teaching can be started. The "learnt" PCM (ECM) compares the vehicle specific data from the tester with the stored data. If the data are correct, the teaching can proceed.

If incorrect vehicle specific data have been sent to the PCM (ECM) three times, the PCM (ECM) will reject the request of key teaching for one hour. This time cannot be reduced by disconnecting the battery or any other manipulation. After reconnecting the battery, the timer starts again for one hour.

The key teaching is done by ignition on with the key and additional tester commands. The PCM (ECM) stores the relevant data in the EEPROM and in the transponder. Then the PCM (ECM) runs the authentication required for confirmation of the teaching process. The successful programming is then confirmed by a message to the tester.

If the key is already known to the PCM (ECM) from a previous teaching, the authentication will be accepted and the EEPROM data are updated. There is no changed transponder content (this is impossible for a learnt transponder).

The attempt to repeatedly teach a key, which has been taught already during the same teaching cycle, is recognized by the PCM (ECM). This rejects the key and a message is sent to the tester.

The PCM (ECM) rejects invalid keys, which are presented for teaching. A message is sent to the tester. The key can be invalid due to faults in the transponder or other reasons, which result from unsuccessful programming of data. If the PCM (ECM) detects different authenticators of a transponder and an PCM (ECM), the key is considered to be invalid.

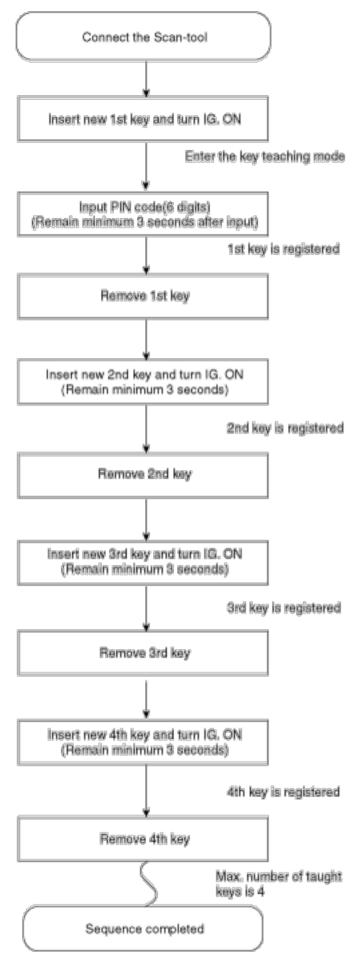
The maximum number of taught keys is 8

If an error occurs during the Immobilizer Service Menu, the PCM (ECM) status remains unchanged and a specific fault code is stored.

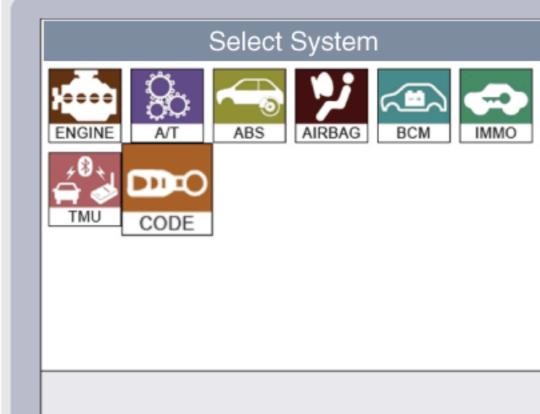
If the PCM (ECM) status and the key status do not match for teaching of keys, the tester procedure will be stopped and a specific fault code will be stored at PCM (ECM).

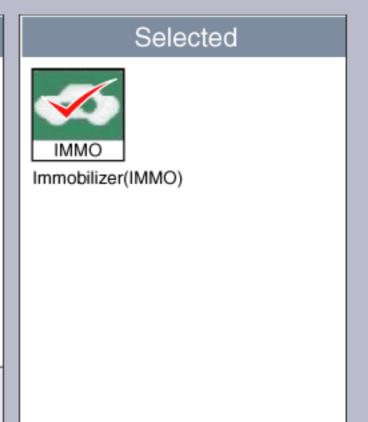
### NOTICE

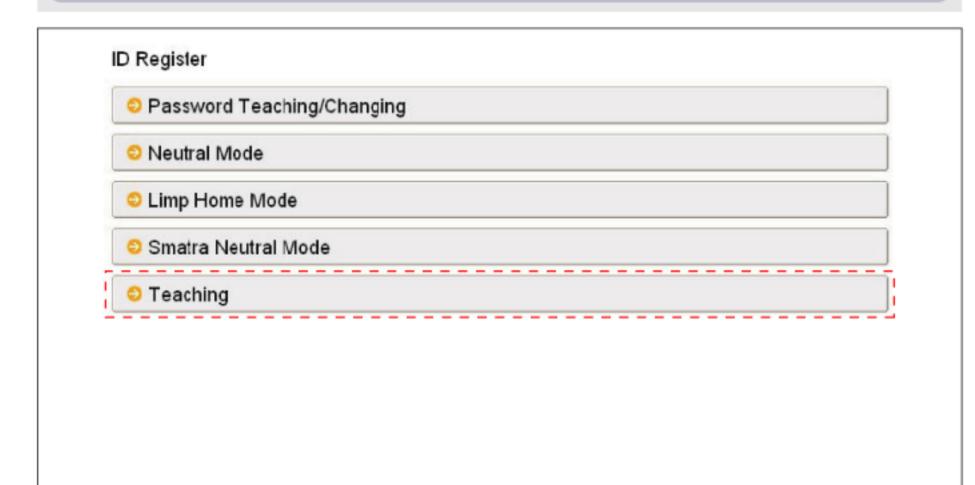
When teaching the 1st key, Smartra regists at the same time.

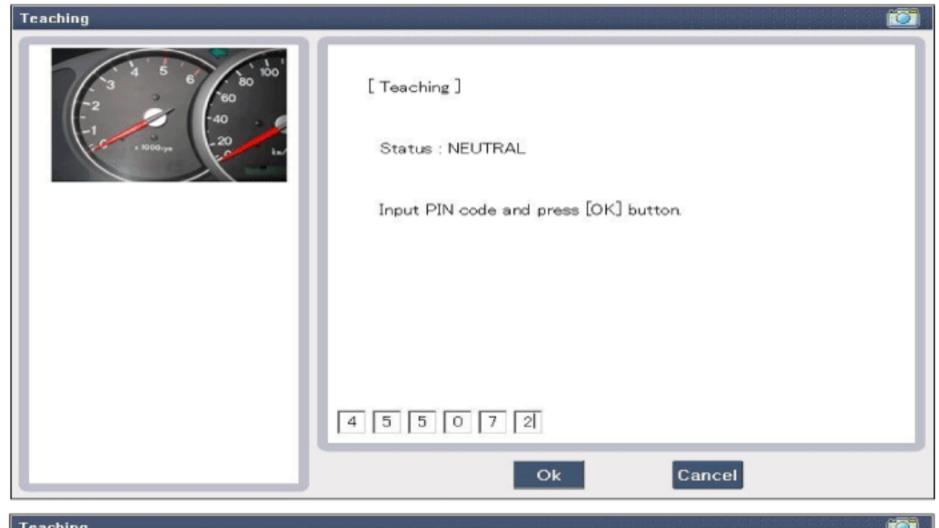


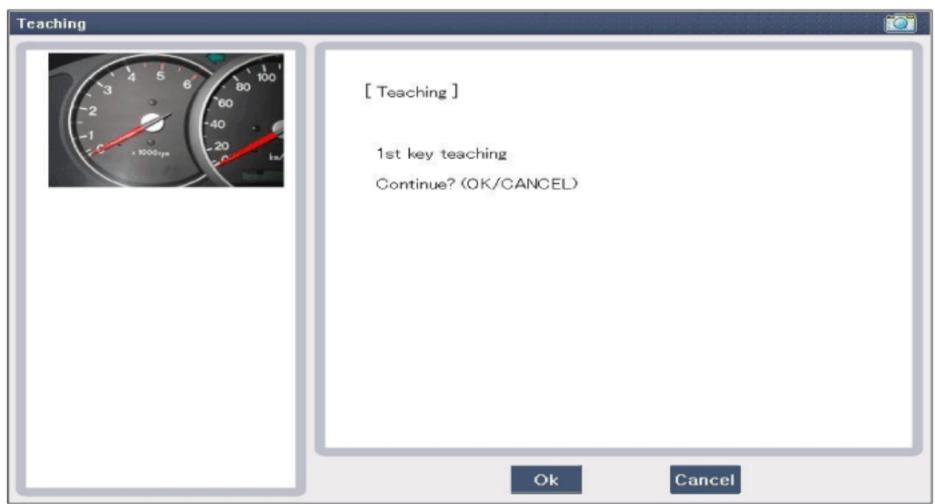
(1) PCM (ECM) learnt status.

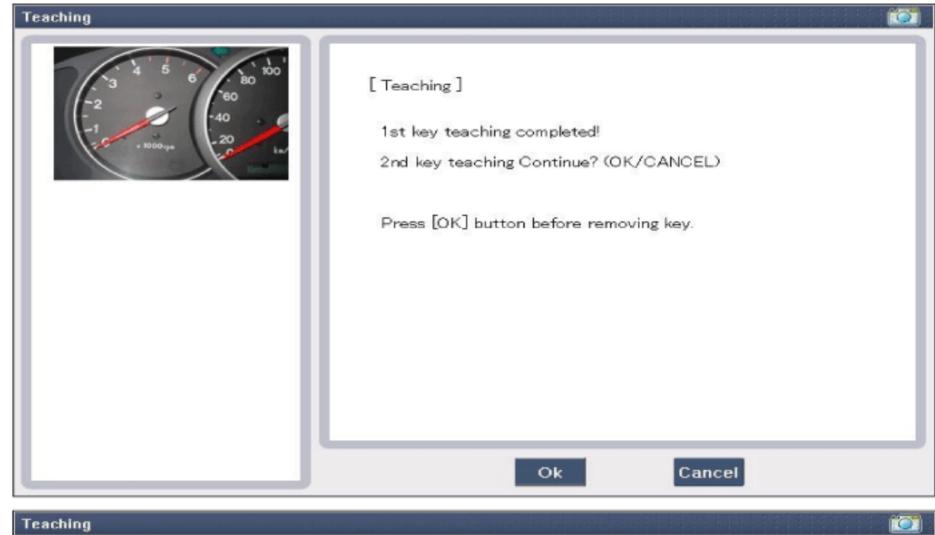


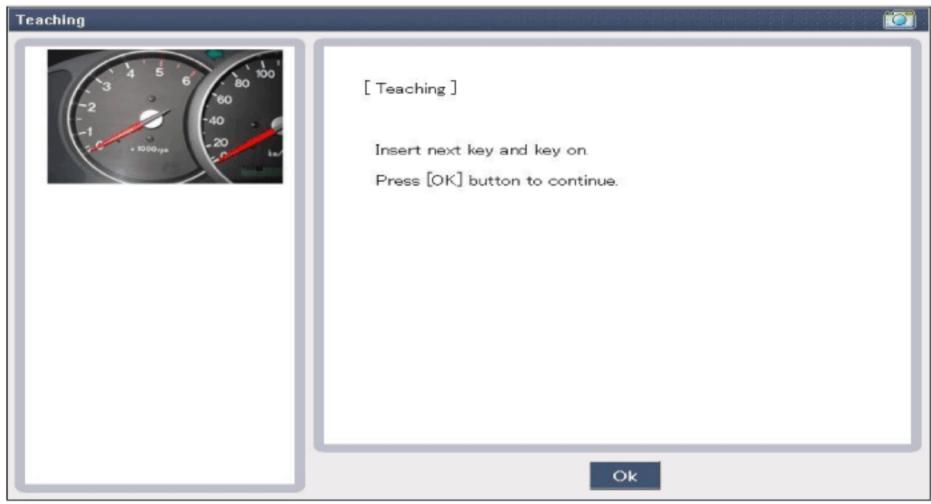


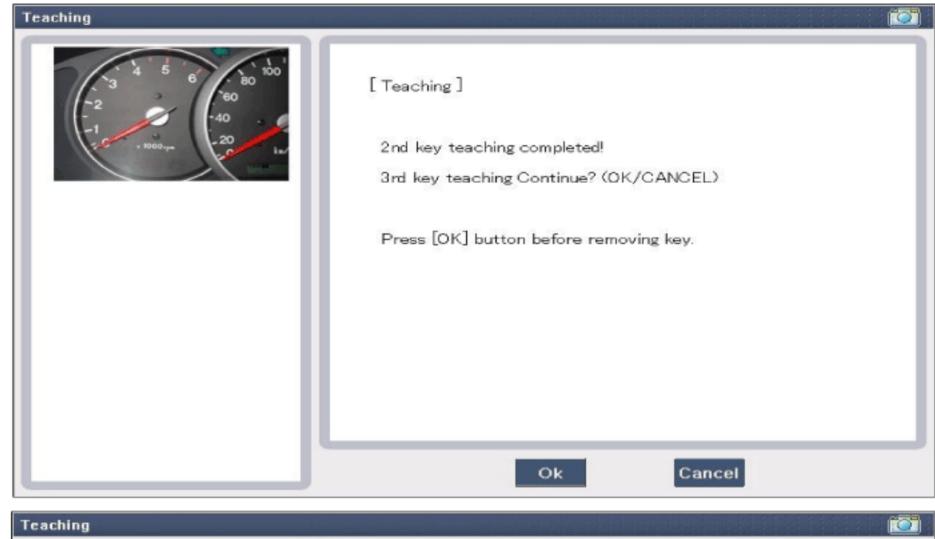


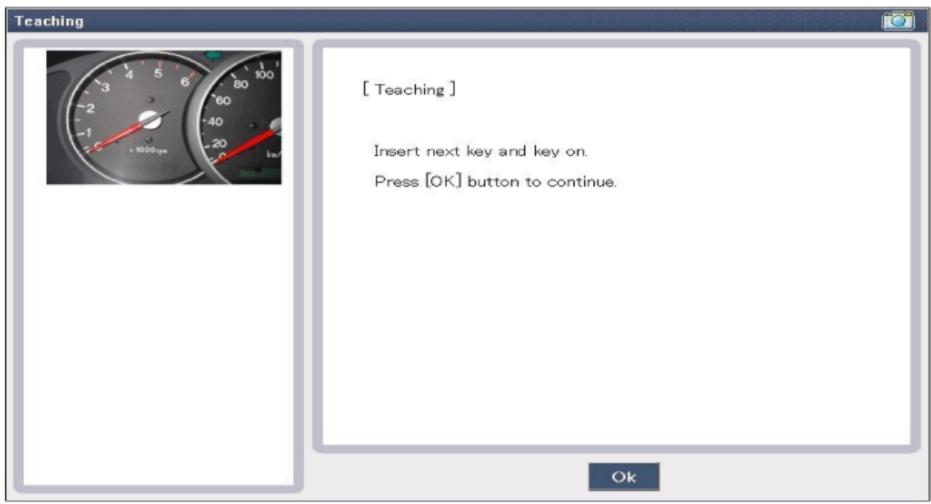


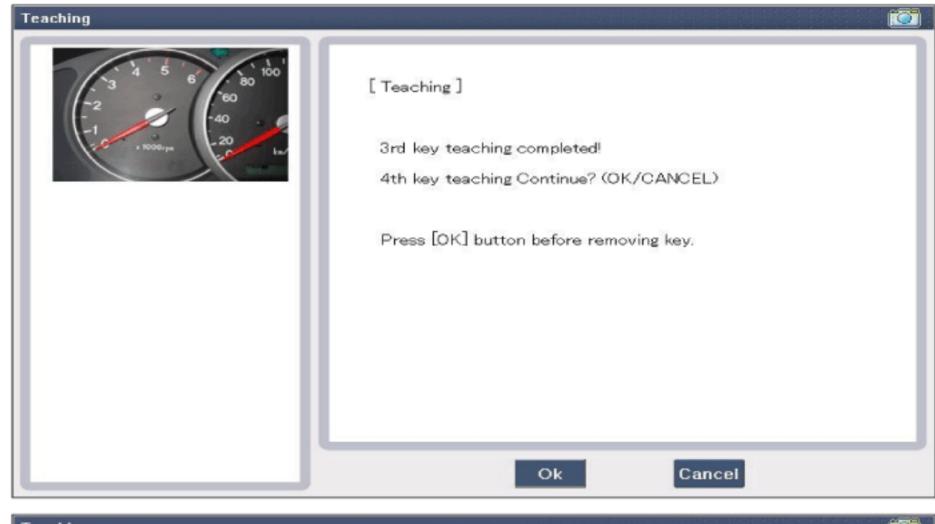


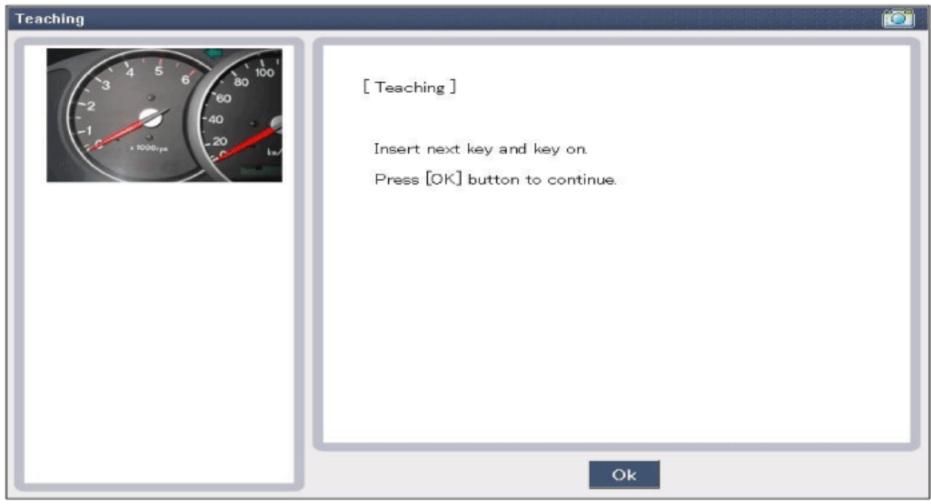


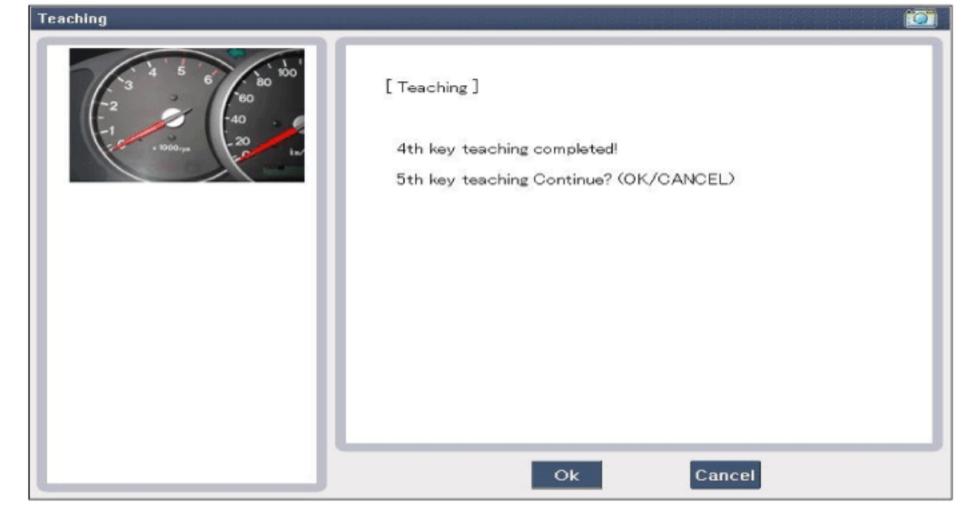












#### (2) PCM (ECM) virgin status.

After replacing new "PCM (ECM)" GDS displays that PCM (ECM) is virgin status in Key Teaching mode.

"VIRGIN" status means that PCM (ECM) has not matched any PIN code before.

#### 2. User Password Teaching Procedure

The user password for limp home is taught at the service station. The owner of the vehicle can select a number with four digits.

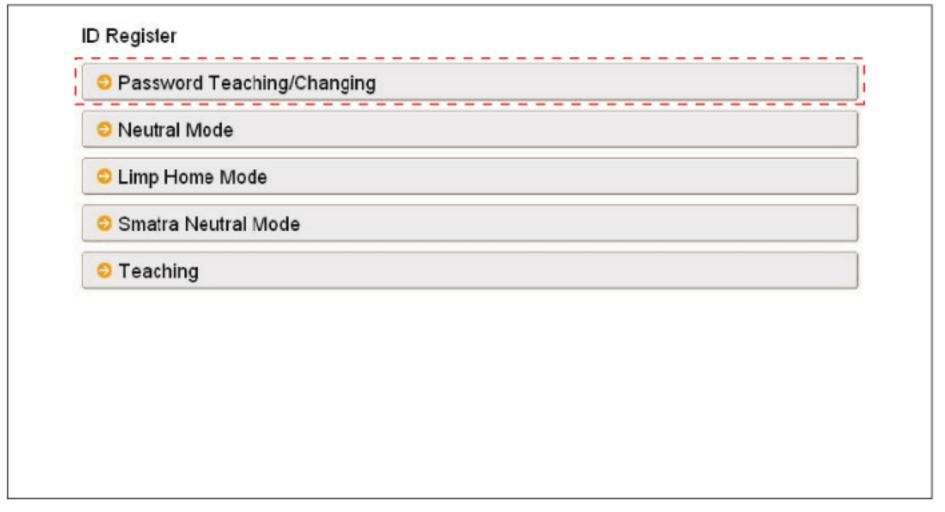
The user password teaching is only accepted by a "learnt" PCM (ECM). Before first teaching of user password to an PCM (ECM), the status of the password is "virgin" No limp home function is possible.

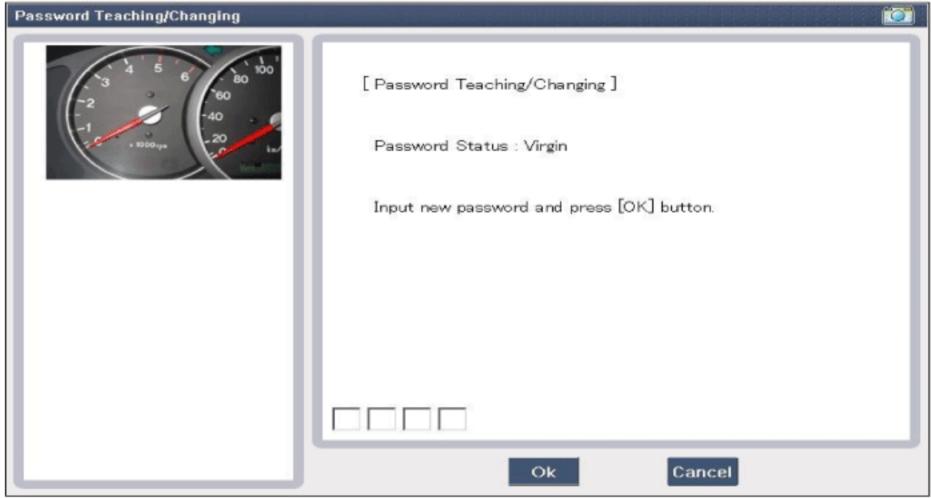
The teaching is started by ignition on, with a valid key (learnt key) and sending the user password by tester. After successful teaching, the status of the user password changes from "virgin" to "learnt"

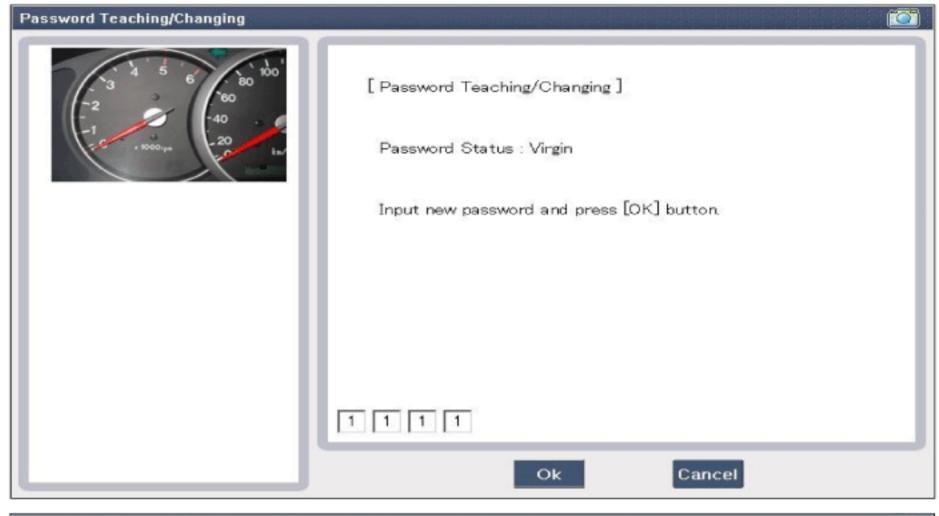
The learnt user password can also be changed. This can be done if the user password status is "learnt" and the tester sends authorization of access, either the old user password or the vehicle specific data. After correct authorization, the PCM (ECM) requests the new user password. The status remains "learnt" and the new user password will be valid for the next limp home mode.

If wrong user passwords or wrong vehicle specific data have been sent to the PCM (ECM) three times continuously or intermittently, the PCM (ECM) will reject the request to change the password for one hour. This time cannot be reduced by disconnecting the battery or any other actions. After reconnecting the battery, the timer starts again for one hour.

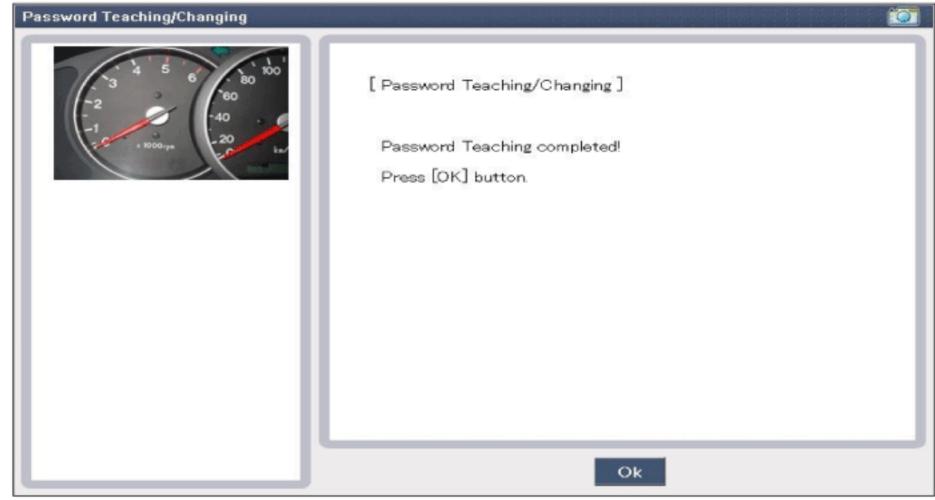
(1) User password teaching





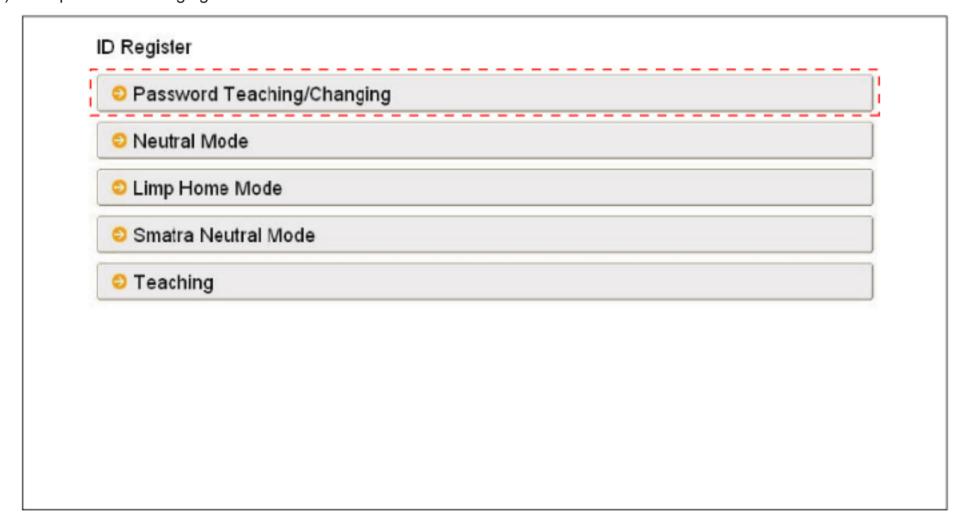


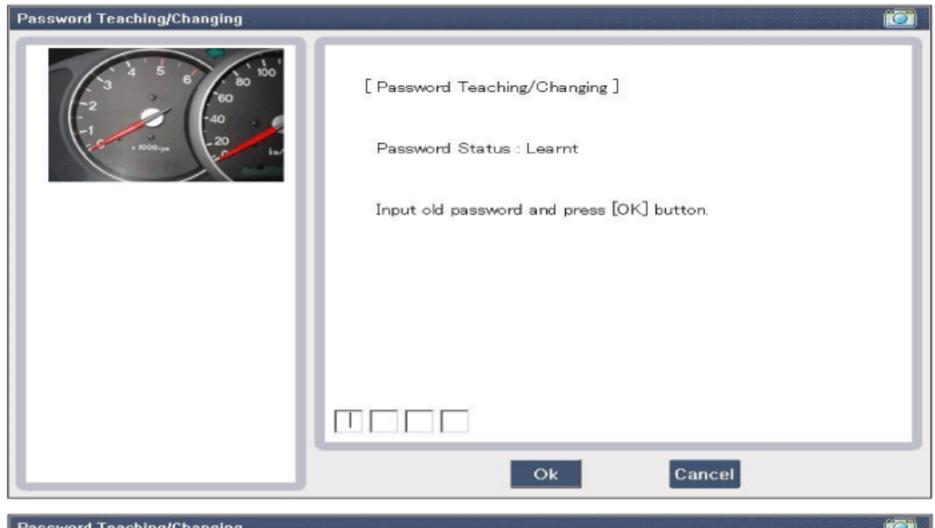


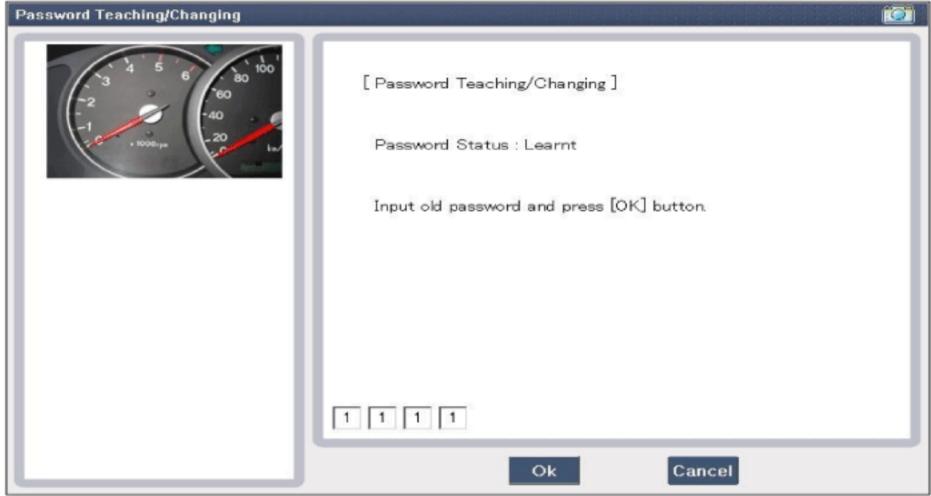


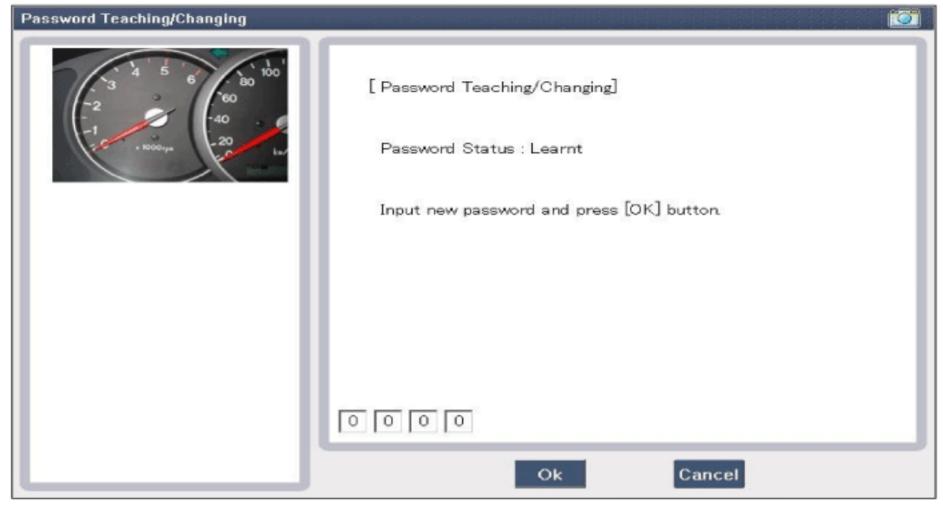
\* In case of putting wrong password, retry from first step after 10 seconds.

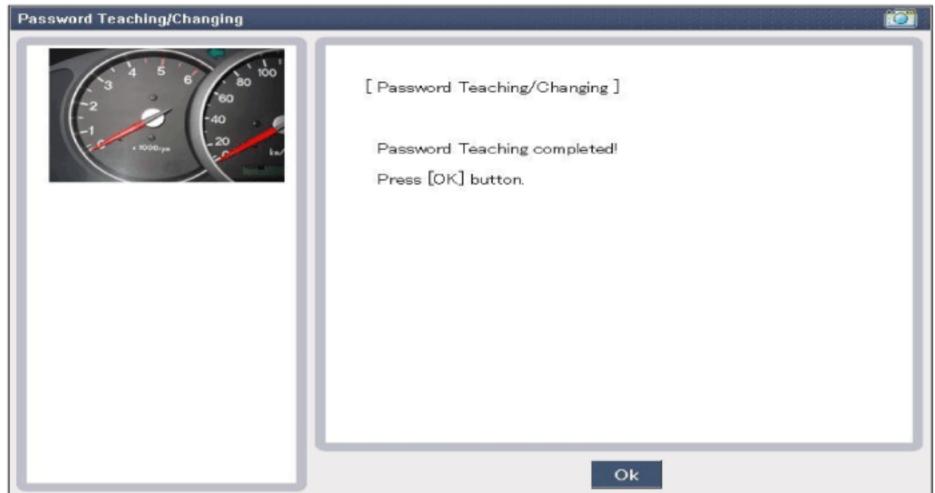
## (2) User password changing











#### LIMP HOME FUNCTION

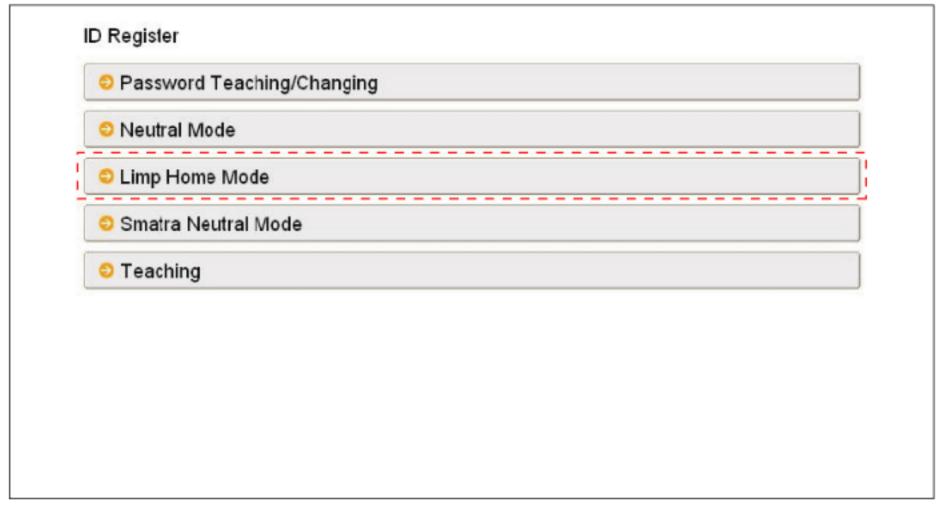
1. Limp Home By Tester

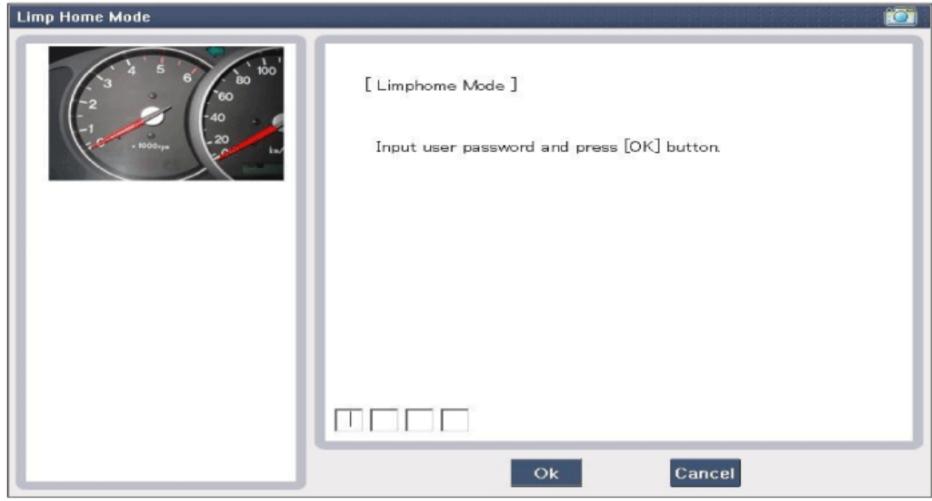
If the PCM (ECM) detects the fault of the SMARTRA or transponder, the PCM (ECM) will allow limp home function of the immobilizer. Limp home is only possible if the user password (4 digits) has been given to the PCM (ECM) before. This password can be selected by the vehicle owner and is programmed at the service station.

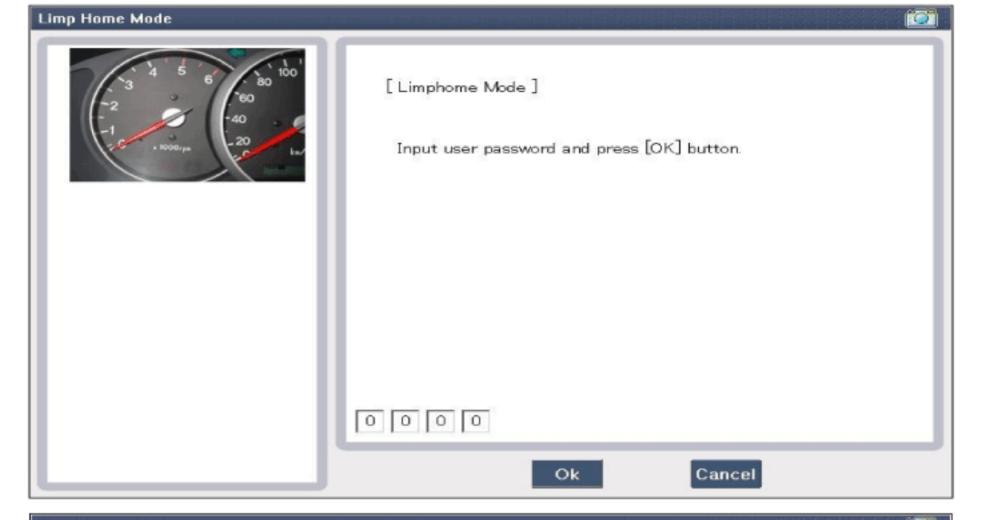
The user password can be sent to the PCM (ECM) via the special tester menu.

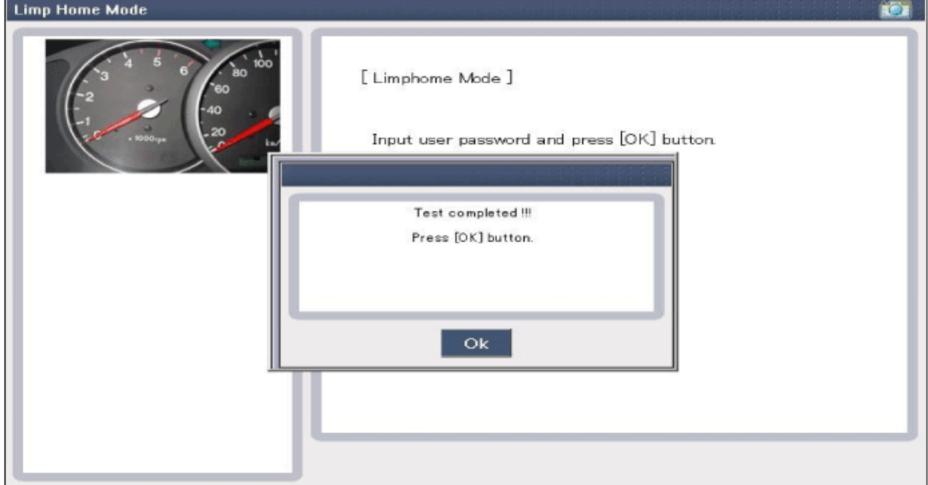
Only if the PCM (ECM) is in status "learnt" and the user password status is "learnt" and the user password is correct, the PCM (ECM) will be unlocked for a period of time (30 sec.). The engine can only be started during this time. After the time has elapsed, engine start is not possible.

If the wrong user password is sent, the PCM (ECM) will reject the request of limp home for one hour. Disconnecting the battery or any other action cannot reduce this time. After connecting the battery to the PCM (ECM), the timer starts again for one hour.









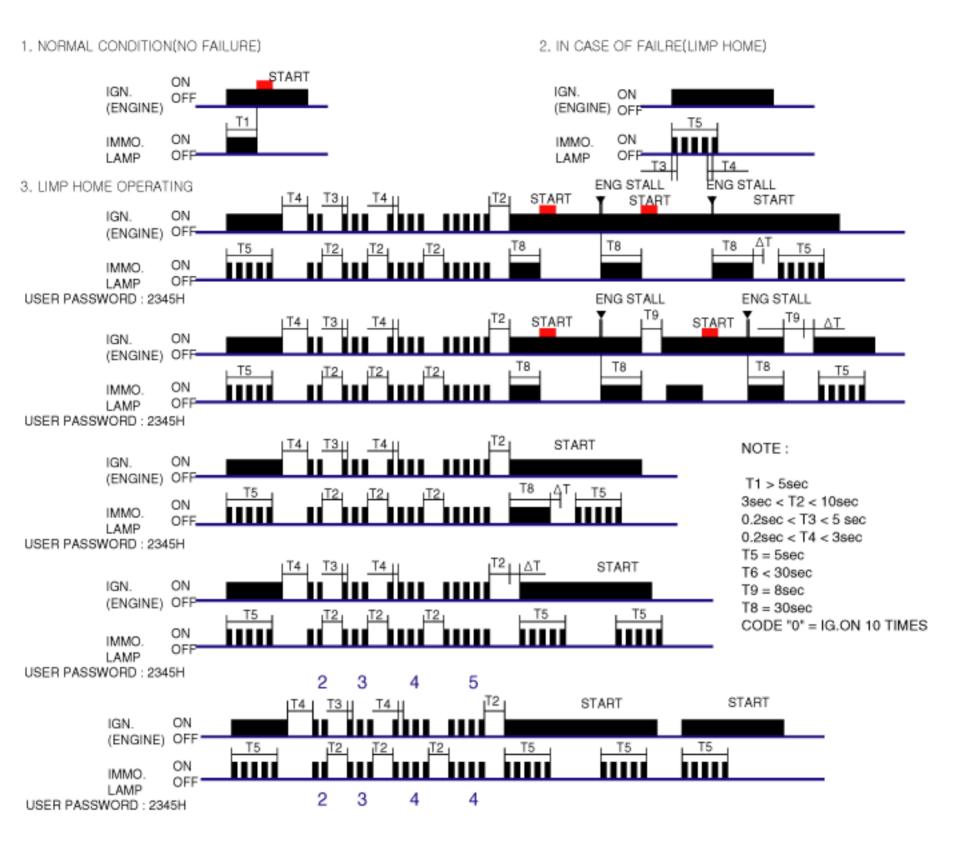
#### 2. Limp Home By Ignition Key

The limp home can be activated also by the ignition key. The user password can be input to the PCM (ECM) by a special sequence of ignition on/off.

Only if the PCM (ECM) is in status "learnt" and the user password status is "learnt" and the user password is correct, the PCM (ECM) will be unlocked for a period of time (30 sec.).

The engine can be started during this time. After the time has elapsed, engine start is not possible. After a new password has been input, the timer (30 sec.) will start again.

After ignition off, the PCM (ECM) is locked if the timer has elapsed 8 seconds. For the next start, the input of the user password is requested again.



#### REPLACEMENT

## **Problems And Replacement Parts:**

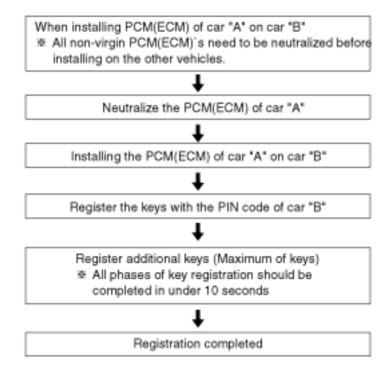
Problem	Part set	GDS required?
All keys have been lost	Blank key (4)	YES
Antenna coil unit does not work	Antenna coil unit	NO
ECM does not work	PCM (ECM)	YES
Ignition switch does not work	Ignition switch with Antenna coil unit	YES
Unidentified vehicle specific data occurs	Key, PCM (ECM)	YES
SMARTRA unit does not work	SMARTRA unit	YES

#### Replacement Of ECM And Smartra

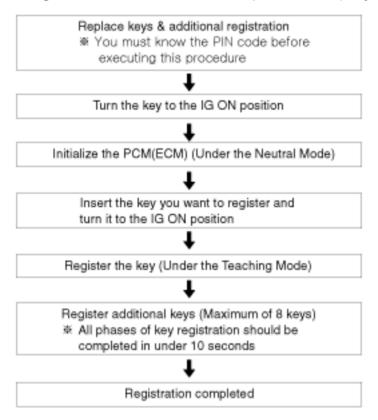
In case of a defective ECM, the unit has to be replaced with a "virgin" or "neutral" ECM. All keys have to be taught to the new ECM. Keys, which are not taught to the ECM, are invalid for the new ECM (Refer to key teaching procedure). The vehicle specific data have to be left unchanged due to the unique programming of transponder.

In case of a defective SMARTRA, it needs teaching the smartra. A new SMARTRA device replaces the old one and smartra need teaching.

1. Things to remember before a replacement (PCM (ECM))



2. Things to remember before a replacement (Keys & Additional registration)



#### NOTICE

- 1) When there is only one key registered and you wish to register another key, you need to re-register the key which was already registered.
- 2) When the key #1 is registered and master key #2 is not registered, Put the key #1 in the IG/ON or the start position and remove it. The engine can be started with the unregistered key #2.

  (Note that key #2 must be used within 10 seconds of removing key #1)
- 3) When the key #1 is registered and key #2 is not registered, put the unregistered master key #2 in the IG/ON or the start position.
  - The engine cannot be started even with the registered key #1.
- 4) When you inspect the immobilizer system, refer to the above paragraphs 1, 2 and 3. Always remember the 10 seconds zone.
- 5) If the pin code & password are entered incorrectly on three consecutive inputs, the system will be locked for one hour.
- 6) Be cautious not to overlap the transponder areas.
- 7) Problems can occur at key registration or vehicle starting if the transponders should overlap.

## Neutralizing Of ECM

The PCM (ECM) can be set to the "neutral" status by a tester.

A valid ignition key is inserted and after ignition on is recorded, the PCM (ECM) requests the vehicle specific data from the tester. The

communication messages are described at "Neutral Mode" After successfully receiving the data, the PCM (ECM) is neutralized.

The ECM remains locked. Neither the limp home mode nor the "twice ignition on" function, is accepted by the PCM (ECM).

The teaching of keys follows the procedure described for the virgin PCM (ECM). The vehicle specific data have to be unchanged due to the unique programming of the transponder. If data should be changed, new keys with a virgin transponder are requested.

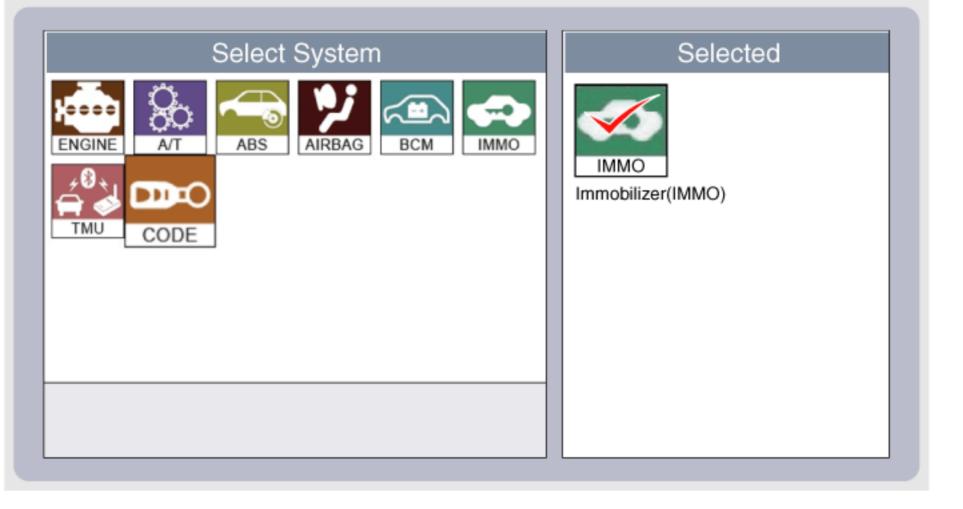
This function is for neutralizing the PCM (ECM) and Key. Ex) when lost key, Neutralize the PCM (ECM) then teach keys.

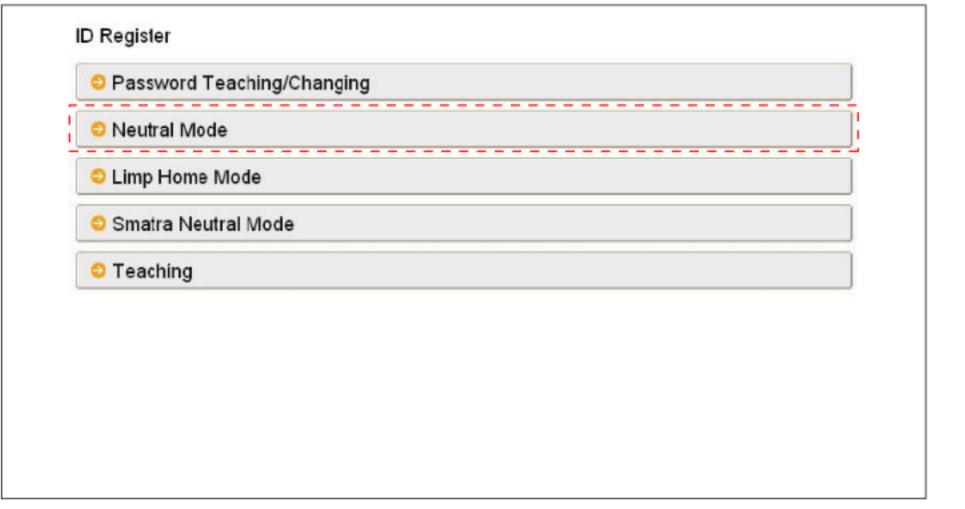
(Refer to the Things to do when Key & PIN Code the PCM (ECM) can be set to the "neutral" status by a scanner. If wrong vehicle specific data have been sent to SMATRA three times continuously or intermittently, the SMATRA will reject the request to enter neutral mode for one hour. Disconnecting the battery or other manipulation cannot reduce this time. After connecting the battery the timer starts again for one hour.

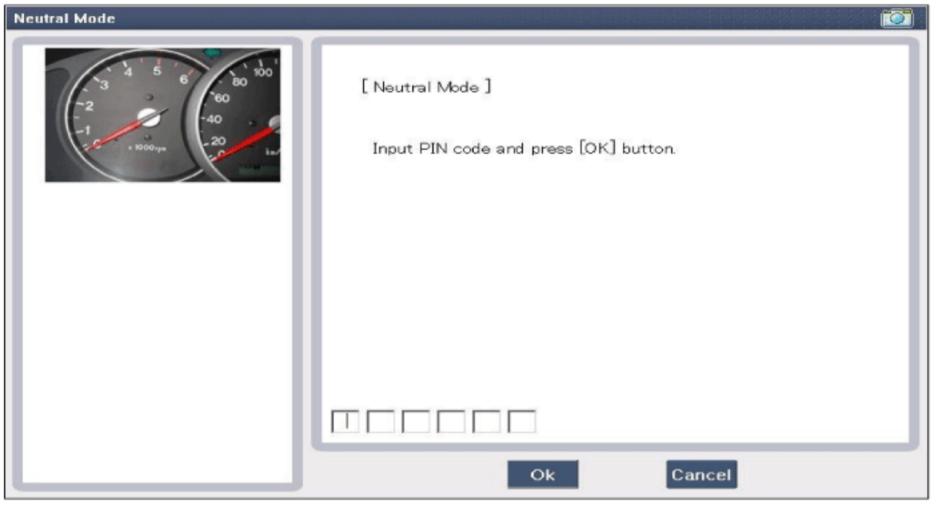
## NOTICE

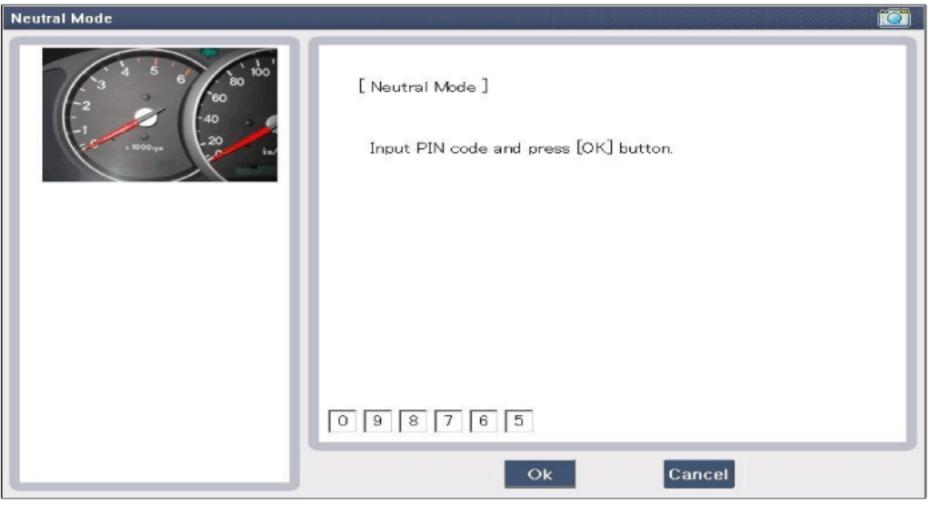
- · Neutralizing setting condition
  - In case of PCM (ECM) status "Learnt" regardless of user password "Virgin or Learnt"
  - Input correct PIN code by scanner.
  - Neutralizing meaning .
    - : PIN code (6) & user password (4) deletion.
    - : Locking of ECM (except key teaching permission)
- Neutralizing meaning:
  - PIN Code (6) & User P/Word (4) deletion
  - Locking of EMS (except Key Learning permission)

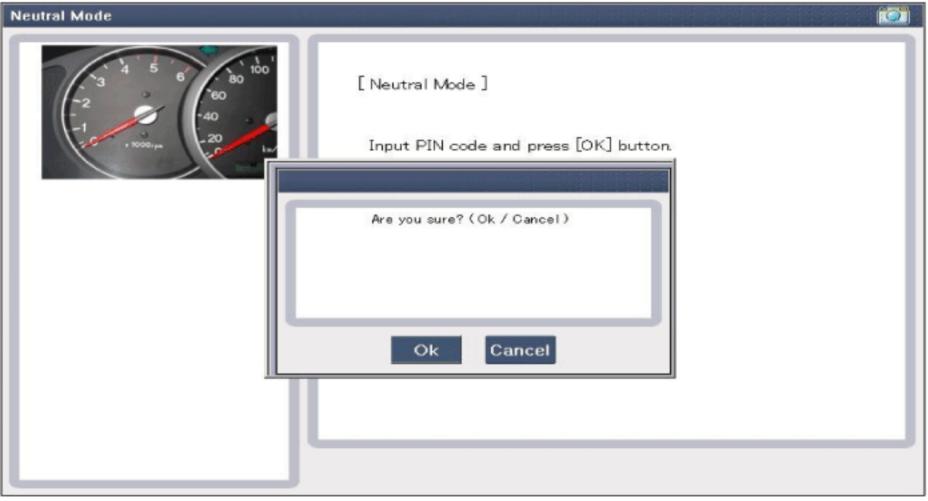
Function	Engine Running			Learning		
EMS	Learnt Key		Twice Ignition	Key	User Password	
Neutral	No	No	No	Yes	No	

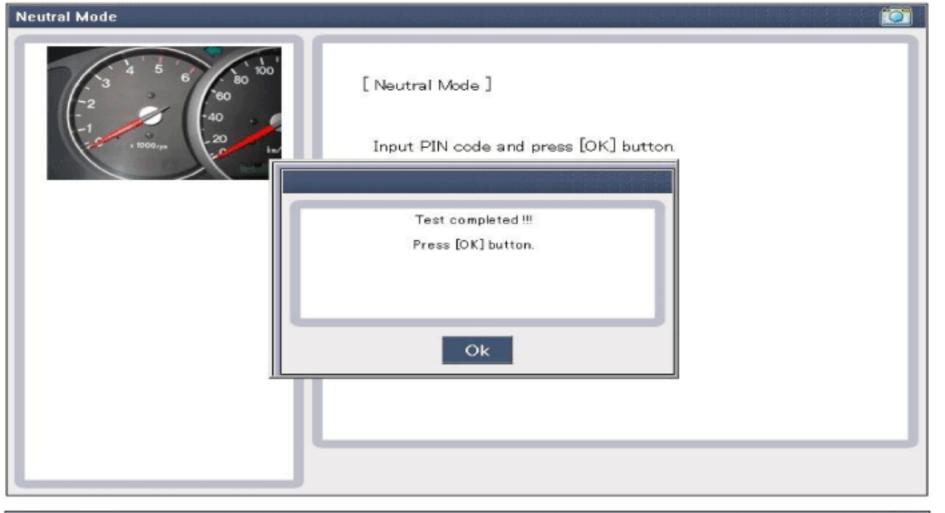


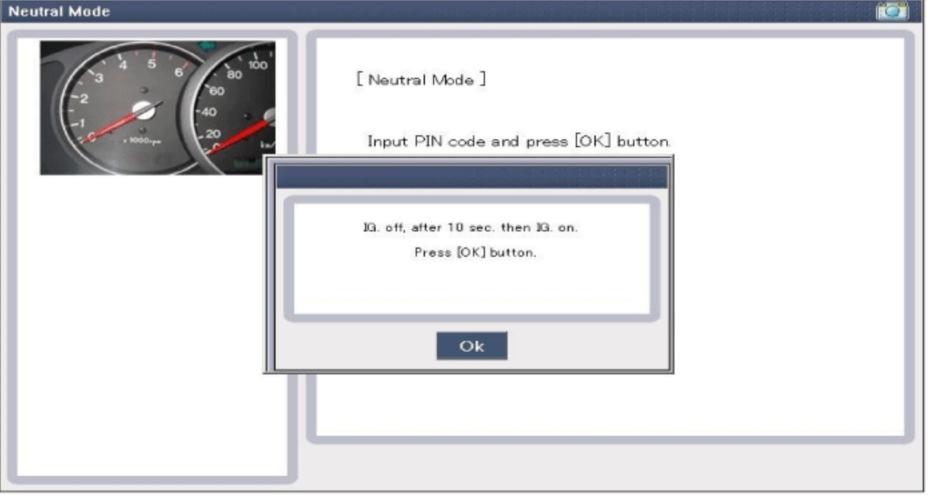


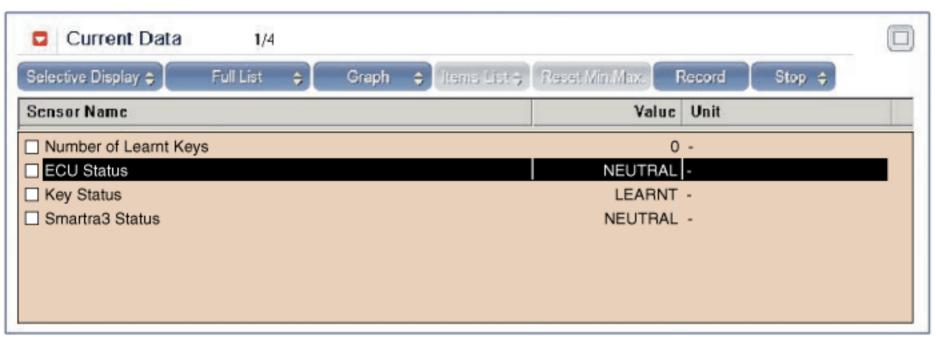












The EMS can be set to the status "neutral" by tester

Ignition key (regardless of key status) is inserted and after IGN ON. If receiving the correct vehicle password from GST, SMARTRA can be neutralized. The neutralization of SMARTRA is possible if DPN is same as the value inputted by GST.

In case that the SMARTRA status is neutral, the EMS keeps the lock state. And the start is not possible by "twice ignition".

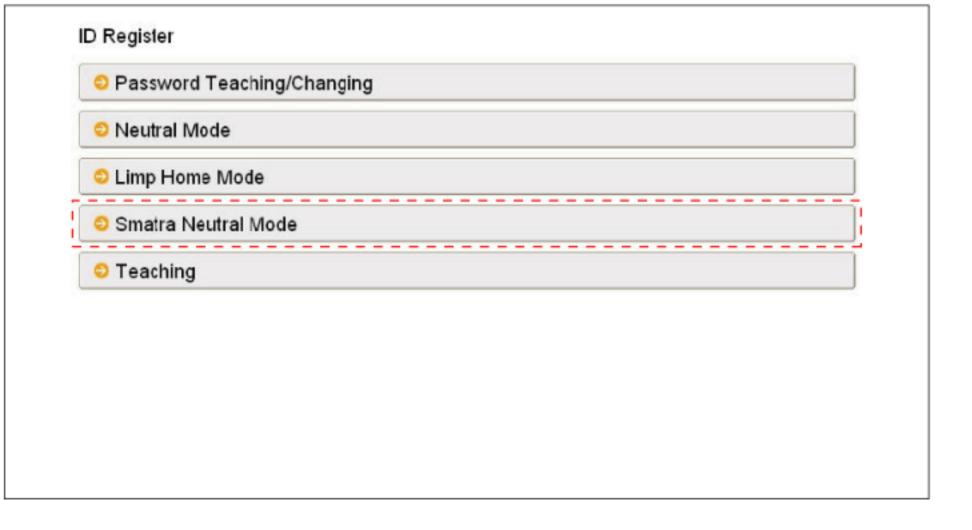
In case of changing the vehicle password, new virgin transponder must be only used. And in case of virgin key, after Learning the key of vehicle password, it can be used.

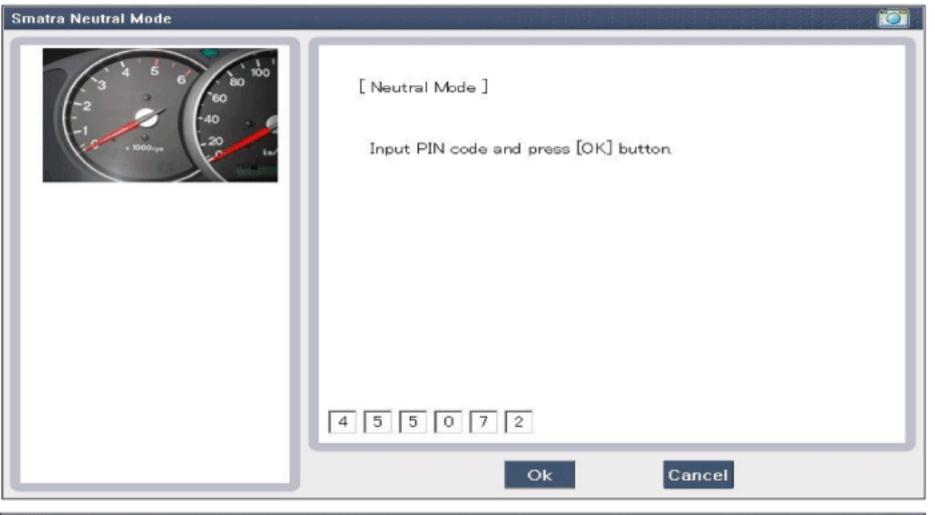
If wrong vehicle specific data have been sent to SMATRA three times continuously or intermittently, the SMATRA will reject the request to enter neutral mode for one hour. Disconnecting the battery or other manipulation cannot reduce this time. After connecting the battery the timer starts again for one hour.

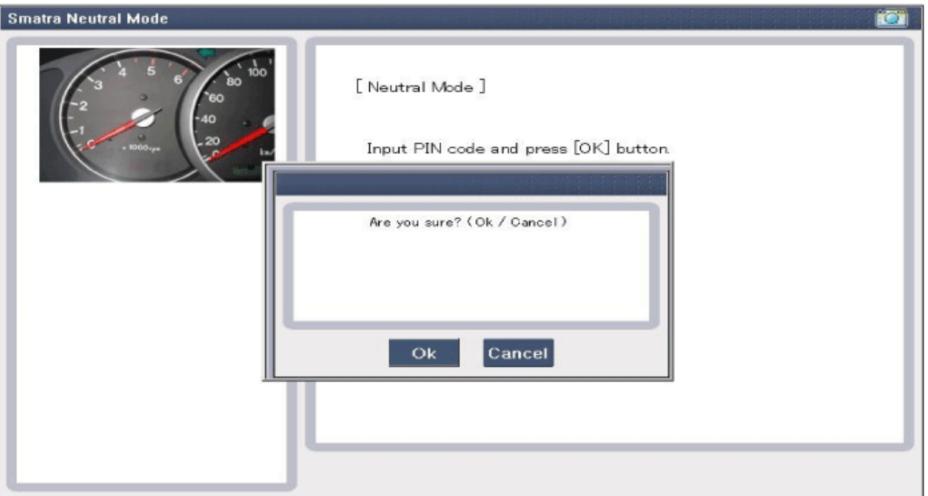
## **NOTICE**

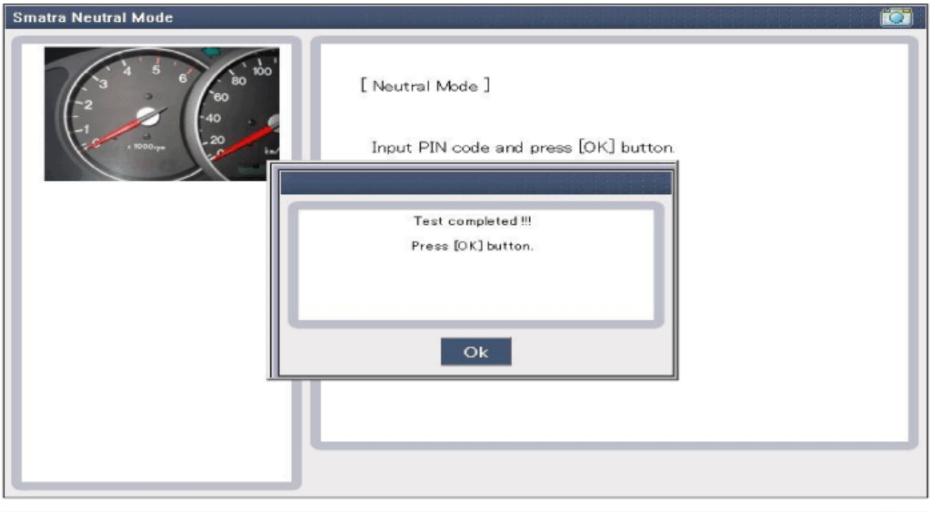
- Neutralizing Setting condition :
  - In case of "SMARTRA status", "Learnt"
  - Input correct Pin code by tester
- · Neutralizing meaning:
  - Vehicle password (DPN Code) & SEK Code deletion.
  - Permission of New DPN Learning.

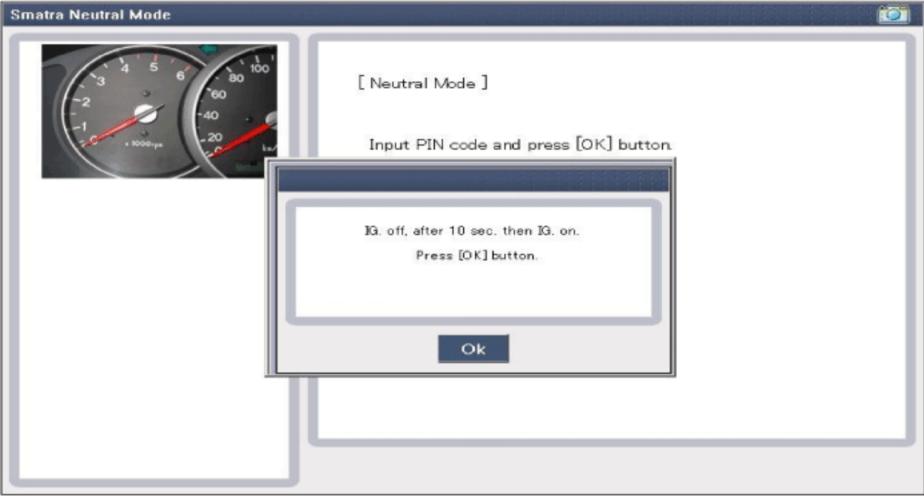
Function	Engine Running			Learning	
SMARTRA	Learnt Key	Limp home	Twice Ignition	Key	User Password
Neutral	No	Yes (EMS learnt)	No	Yes	No

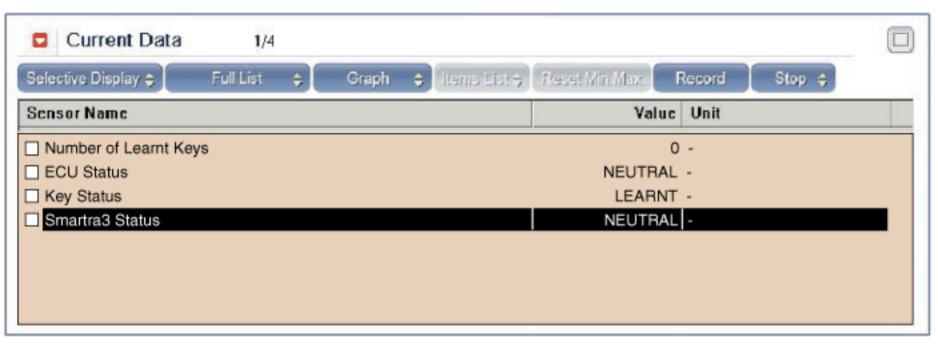




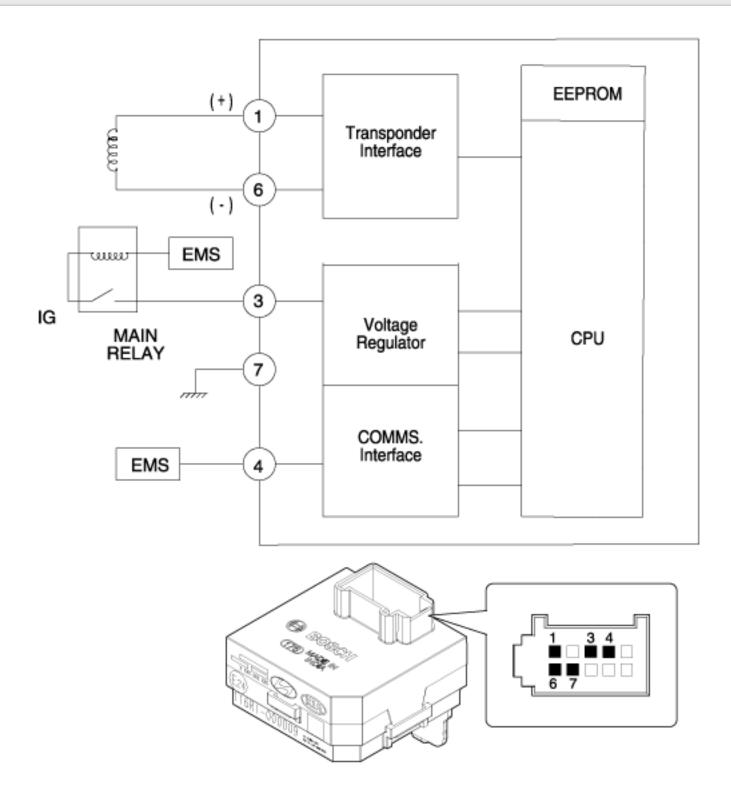






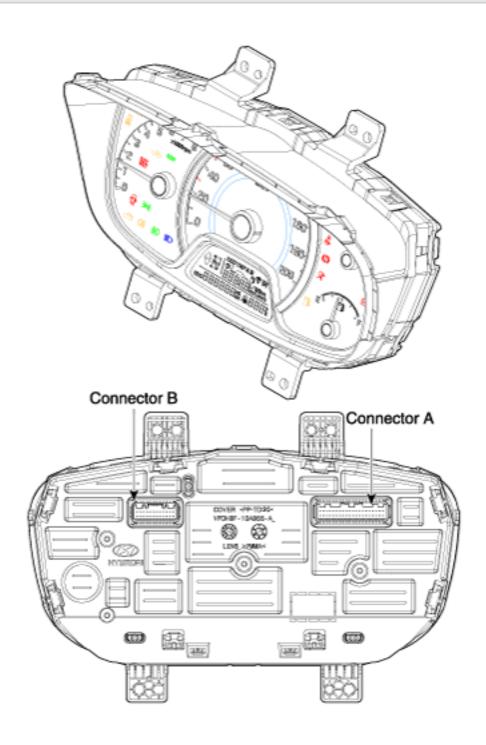


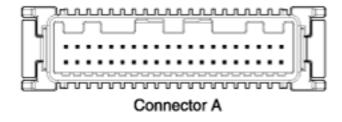
## **CIRCUIT DIARAM**

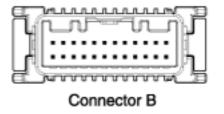


No.	Name	Description		
1	Antenna coil (+)	Connector pin for external antenna		
3	IGN	Power to the IMMO		
4	COM_EMS	K-line communication between ECU and IMMO		
6 Antenna coil (-)		Connector pin for external antenna		
7	GND	Ground		

## **COMPONENTS**







# [General]

No	Description	No	Description			
A1	Signal 3 GND	A21	Trip switch GND			
A2	-	A22	Trip switch 1 +			
A3	-	A23	-			
A4	-	A24	Oil pressure switch			

A5	-	A25	Brake input
A6	Airbag +	A26	Speed output
A7	Turn left lamp (LH)	A27	Turn right lamp
A8	Dorr switch	A28	-
A9	High beam lamp +	A29	-
A10	LPI fuel (only LPI)	A30	-
A11	Immobilizer	A31	-
A12	LPI fuel GND (only LPI)	A32	C CAN high
A13	Low beam lamp +	A33	C CAN low
A14	Fuel +	A34	-
A15	Alternator L	A35	Alternator L
A16	Fuel GND	A36	Signal 2 GND
A17	-	A37	Signal 1 GND
A18	Speed input	A38	Seat belt switch
A19	-	A39	IGN 1
A20	Tail lamp	A40	B+
No	Description	No	Description
B1		D12	_
ы	-	B13	-
B2	Trunk open switch	B14	Driver door switch
	Trunk open switch  Rear fog lamp		Driver door switch  D output
B2		B14	
B2 B3	Rear fog lamp	B14 B15	D output
B2 B3 B4	Rear fog lamp  Rear fog switch	B14 B15 B16	D output
B2 B3 B4 B5	Rear fog lamp  Rear fog switch  R output	B14 B15 B16 B17	D output
B2 B3 B4 B5 B6	Rear fog lamp Rear fog switch R output -	B14 B15 B16 B17 B18	D output  Key In switch  -  -
B2 B3 B4 B5 B6 B7	Rear fog lamp Rear fog switch R output - N output	B14 B15 B16 B17 B18 B19	D output  Key In switch  -  -  Rear defogger switch
B2 B3 B4 B5 B6 B7 B8	Rear fog lamp Rear fog switch R output - N output Water separator	B14 B15 B16 B17 B18 B19 B20	D output  Key In switch  -  Rear defogger switch  S output
B2 B3 B4 B5 B6 B7 B8 B9	Rear fog lamp Rear fog switch R output - N output Water separator -	B14 B15 B16 B17 B18 B19 B20 B21	D output  Key In switch  Rear defogger switch S output -
B2 B3 B4 B5 B6 B7 B8 B9 B10	Rear fog lamp Rear fog switch R output - N output Water separator - P output	B14 B15 B16 B17 B18 B19 B20 B21 B22	D output  Key In switch  Rear defogger switch S output - R input (MT)
B2 B3 B4 B5 B6 B7 B8 B9 B10 B11	Rear fog lamp Rear fog switch R output - N output Water separator - P output -	B14 B15 B16 B17 B18 B19 B20 B21 B22 B23	D output  Key In switch  Rear defogger switch S output - R input (MT) Front fog lamp
B2 B3 B4 B5 B6 B7 B8 B9 B10 B11	Rear fog lamp Rear fog switch R output - N output Water separator - P output -	B14 B15 B16 B17 B18 B19 B20 B21 B22 B23	D output  Key In switch  Rear defogger switch S output - R input (MT) Front fog lamp
B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12	Rear fog lamp Rear fog switch R output - N output Water separator - P output -	B14 B15 B16 B17 B18 B19 B20 B21 B22 B23	D output  Key In switch  Rear defogger switch S output - R input (MT) Front fog lamp

A4

A5

A6

A7

B8	Water separator	B20	S output						
В9	-	B21	-						
B10	P output	B22	R input (MT)						
B11	-	- B23							
B12	Rear defogger relay	B24	-						
[With SJB]									
[With SJB]	Description	No	Description						
-	<b>Description</b> Signal 3 GND	<b>No</b> A21	<b>Description</b> Trip switch GND						
No	·								

Airbag +

A24

A25

A26

A27

Oil pressure switch

Speed output

A8	-	A28	-
A9	-	A29	B CAN high
A10	LPI fuel (only LPI)	A30	B CAN low
A11	Immobilizer	A31	-
A12	LPI fuel GND (only LPI)	A32	C CAN high
A13	-	A33	C CAN low
A14	Fuel +	A34	-
A15	Alternator L	A35	Alternator L
A16	Fuel GND	A36	Signal 2 GND
A17		A37	Signal 1 GND
A18	Speed input	A38	-
A19		A39	IGN 1
A20	Tail lamp	A40	B+

No	Description	No	Description
B1	-	B13	-
B2	-	B14	-
В3	-	B15	D output
B4	Rear fog switch	B16	-
B5	R output	B17	-
B6	-	B18	-
В7	N output	B19	Rear defogger switch
B8	Water separator	B20	S output
В9	-	B21	-
B10	P output	B22	R input (MT)
B11	-	B23	Front fog lamp
B12	Rear defogger relay	B24	-

# **INSPECTION**

1. Check the functionality refer to below table information when indicator warning has a problem

No	Telltale Symbol	Feature Name	Communication	Signal Source	Variant	Check point
1		Airbag	C-CAN	Air bag module	ALL Variant	CAN signal
2	=	Lighboom	B-CAN	SJB	Mid Grade	CAN signal
2		Highbeam	Hardwire	Multi-function switch	Low Grade	Hardwire input
3	<b>≣</b> D	LowBeam	B-CAN	SJB	Mid Grade	CAN signal
4		Immobilizer	Hardwire	Immobilizer	ALL Variant	Hardwire input
5			B-CAN	SJB	Mid Grade	CAN signal
3		Door Open	Hardwire	Door switch	Low Grade	Hardwaire input
6	4	Turn Left	B-CAN	SJB	Mid Grade	CAN signal
0		Tuni Leit	Hardwire	Multi-function switch	Low Grade	Hardwaire input
7		Turne Disabet	B-CAN	SJB	Mid Grade	CAN signal
7		Turn Right	Hardwire	Multi-function switch	Low Grade	Hardwaire input
			C-CAN	ABS module	Mid C	CANL
			B-CAN	ESC module SJB	Mid Grade	CAN signal
			D-CAIN	SJD		

8	715	Parking Brake & EBD	Hardwire	Parking brake switch		Hardwaire input
	(!)			ABS module		
			C-CAN	ESC module	Low Grade	CAN signal
			Hardwire	Parking brake switch	Low Grade	Hardwaire input
9		Trunk Onon	B-CAN	SJB	Mid Grade	CAN signal
9		TrunK Open	Hardwire	Trunk switch	Low Grade	Hardwaire input
10	<u> </u>	Poor Fog	B-CAN	SJB	Mid Grade	CAN signal
10	Rear Fog		Hardwire	Multi-function switch	Low Grade	Hardwaire input
11	4N	Front Fog	B-CAN	SJB	Mid Grade	CAN signal
''	チリ	T TOTIL T OG	Hardwire (Micro Read & Micro Driven)	Multi-function switch	Low Grade	Hardwaire input
12		Water Seperator	Hardwire	Fuel filter	ALL Variant (Diesel Only)	Hardwaire input
13	4(	Check engine	C-CAN	EMS	ALL Variant	CAN signal
14	700	Glow plug	C-CAN	EMS	ALL Variant (Diesel only)	CAN signal
15		Oil Pressure	C-CAN	Oil pressue sensor	ALL Variant	Hardwaire input
16		ADC	C-CAN	ABS module	ALL Variant	CAN signal
10	(ABS)	ABS	O-CAIN	ESC module	ALL VAIIAIII	CAN signal

17	\$\frac{1}{2}	ESC	C-CAN	ESC module	ALL Variant	CAN signal
18	OFF	ESC OFF	C-CAN	ESC module	ALL Variant	CAN signal
19	<b>Θ!</b>	MDPS	C-CAN	MDPS module	ALL Variant	CAN signal
20	- +	Battery Charge	Digital Input (Micro read)	Battery sensor	ALL Variant	Hardwaire input
21		TPMS	C-CAN	TPMS	Mid Grade	CAN signal
22		Low Fuel	Analog Input (Micro read)	Fuel sender	ALL variant	Hardwaire input
23	120 km/h	Over Speed	PWM Input (Micro read)	Speed sensor	M/T Varaint	Hardwaire input
			B-CAN	BA Mid Grade	BA Mid Grade	CAN signal
24	<b>A</b>	Seat Belt	B-CAN	IA	IA	CAN signal
			Hardwire	Low Grade	Low Grade	Hardwaire input
25	KEY OUT	Key Out	B-CAN	SMK	Mid Grade	CAN signal
26	ECO	ECO Green	C-CAN	EMS	A/T Variant only	
27	(A)	ISG Green	C-CAN	EMS	IA Variant ONLY	CAN signal

28	(A)	ISG Yellow	C-CAN	EMS	IA Variant ONLY	CAN signal
29	-) ( -	Tail Lamp	Hardwire	Multi-function switch	All variant	Hardwaire input
30	<b>E</b>	High Temp	C-CAN	EMS	Bifuel Variant ONLY	CAN signal
31	LPG	LPG	C-CAN	EMS	Bifuel Variant ONLY	CAN signal
32	LPG	Low Fuel (LPG)	Hardwire	LPG Sender	Bifuel Variant ONLY	Hardwaire input
33	<b>(3)</b>	Cruise	C-CAN	EMS	IA Variant ONLY	CAN signal
34	SET	SET	C-CAN	EMS	IA Variant ONLY	CAN signal

2. Check the gauge functionality refer to below information when gauge has a problem

	· ·		-	
NO	Gauge	Input type	Input source	Check point
1	Speed gauge	PWM Input	Speed sensor	Check the Pulse input line
2	Tacho gauge	C-CAN	EMS	Check the C-CAN line
3	Coolant temp gauge	C-CAN	EMS	Check the C-CAN line
4	Fuel gauge	Hardwire	Fuel conder	Check the fuel sender resistance value
4			Fuel sender	Check the wiring harness

3. Cluster connector Input/Output pin assignmentthe below table.

### **40P** connector

Pin NO	NAME	I/O	Communication	Communication Check point		
				Normial value	Condition	
1	SIGNAL3_GND	POWER				

2	ILL(-)_Out	DIGITAL OUT	Hardwire	9 ~ 16 V	IGN S/W On
3	Rheo Down SW_In	ANALOG INPUT	Hardwire	Below 2V	IGN On Rheostat down switch On
4	Rheo Up SW_In	ANALOG INPUT	Hardwire	Below 2V	IGN On Rheostat up switch On
5	Outside Temp_In	ANALOG INPUT	Hardwire	0.1 ~ 4.9V	IGN On OAT input signal
6	Airbag+	POWER	Hardwire	9 ~ 16 V	IGN On Air bag Lamp power
7	-				
8	-				
9	-				
10	LPI_Fuel_In	ANALOG INPUT	Hardwire	Empty : below 200ohm Full : above 15ohm	IGN On LPG sender resistance value
11	Immobilizer_In	LOGIC INPUT	Hardwire	Below 2V	BAT On Immobilizer switch On
12	LPI_Fuel_Gnd	GND	Hardwire		LPG sender GND Applicable for Bifuel Only
13	-				
14	Fuel_In	ANALOG INPUT	Hardwire	Empty : below 200ohm Full : above 15ohm	IGN On Fuel sender resistance value
15	Alternator L_Out	DIGITAL OUT	Hardwire	Below 1.5V	IGN On Refer to ISG logic
16	Fuel_GND	GND	Hardwire		
17	Detent_Out	DIGITAL OUT	Hardwire	7 ~ 15V	IGN On Detent out (Rheostat Max)
18	Speed_In	DIGITAL-FREQ. INPUT	Pulse input	0~255Hz	IGN On Speed input
19	NC (IGN2)	GND			
20	Tail Lamp_In	DIGITAL INPUT	Hardwire	9 ~ 16 V	BAT On Tail Lamp input
21	Trip SW_GND	GND	Hardwire		
22	Trip SW1+	ANALOG INPUT	Hardwire	0.7 ~ 4.4V	IGN On Trip Switch1 input
23	Trip SW2+	ANALOG INPUT	Hardwire	0.7 ~ 4.4V	IGN On Trip Switch2 input
24	Oil Pressure SW_In	DIGITAL INPUT	Hardwire	Below 2V	IGN On Oil pressure sensor
25	-				
26	Speed_Out	DIGITAL OUT	Hardwire	0~255Hz	IGN On

27	-				
28	NC( EOL_TX)				
29	B-CAN_L	INPUT & OUTPUT	CAN		
30	B-CAN_H	INPUT & OUTPUT	CAN		
31	NC				
32	C-CAN_H	INPUT & OUTPUT	CAN		
33	C-CAN_L	INPUT & OUTPUT	CAN		
34	NC(EOL_RX)				
35	Alternator L_In	DIGITAL INPUT	Hardwire	Below 2V	IGN On
36	Signal2_GND	GND	Hardwire		
37	Signal1_GND	GND	Hardwire		
38	-				
39	IGN1+	POWER	Hardwire		IGN On
40	B+	POWER	Hardwire		Always

# 24P connector

Dim NO	NAME	I/O	Communication	Check point	
Pin NO				Normial value	Condition
1	DC-DC+	POWER	Hardwire	12V	Always for ISG variant
2	-				
3	-				
4	Rr Fog Sw_In	DIGITAL INPUT	Hardwire	Below 1.5V	IGN On
5	R out	DIGITAL OUT	Hardwire	7 ~ 15V	IGN On
6	-				
7	N out	DIGITAL OUT	Hardwire	7 ~ 15V	IGN On
8	Water Seperator_In	LOGIC INPUT	Hardwire	7 ~ 15V	IGN On
9	-				
10	P out	DIGITAL OUT	Hardwire	7 ~ 15V	IGN On
11	SPARE1	LOGIC INPUT			
12	Rr Defogger Relay_Out	DIGITAL OUT	Hardwire	Below 2V	IGN On
13	-				
14	-				
15	D out	DIGITAL OUT	Hardwire	7 ~ 15V	IGN On
16	-				
17	SPARE2	LOGIC INPUT			
18	SPARE3	LOGIC INPUT			
19	Rr Defogger Sw_In	DIGITAL INPUT	Hardwire	Below 1.5V	IGN On
20	-				
21	SPARE4				

22	M/T R_In	DIGITAL INPUT	Hardwire	7 ~ 15V	
23	-				
24	-				

#### 4. Communication information between cluster and other unit

Transmitting unit	Receiving unit	Communication	Remark
Cluster	ESC,SCC,EMS,Cubis,LDWS	C-CAN(Gateway)	Speed unit, Speed info. Odometer, Cruise state, Start relay state
Cluster	BCM, SJB, SMK	B-CAN(Gateway)	ALT_L, Engine state, Inhibit position, BAT. Voltage, vehicle speed, Transmission type, Speed limit warning
Cluster	ACU	C-CAN	Air bag warning state
ACU	Cluster	C-CAN	Air bag warning state
SJB	Cluster	B-CAN	<ul> <li>Display function</li> <li>Door Open display</li> <li>Seat belt display</li> <li>Parking brake display</li> <li>Turn signal(Hazard) display</li> <li>High beam / Low beam display</li> <li>Hood switch display</li> <li>Rear fog switch display</li> <li>Dark current On/Off switch display</li> <li>Chime(Buzzer) Function</li> <li>Seat belt warning</li> <li>Key operated warning</li> <li>Parking brake warning</li> <li>Sun roof open</li> <li>Key learning sound</li> <li>ICE warning</li> <li>Rear fog warning</li> </ul>
ВСМ	Cluster	B-CAN	Vehicle controlRPAS warning
SMK	Cluster	B-CAN	Warning related with Smart key operating ESCL warning Idout warning
EMS	Cluster	C-CAN	Tacho gauge displayTemp gauge displayEngine check displayGlow plug displayCruise, Set displaySpeed limiter display Shift Indicator display
SAS	Cluster	C-CAN	Steering angle value gateway
TCS	Cluster	C-CAN	ESC OFF status displayState information gateway at SCC modeTCS information display
TCU	Cluster	C-CAN	AT gear position display
ABS	Cluster	C-CAN	ABS state display
ECS	Cluster	C-CAN	ECS state display
MDPS	Cluster	C-CAN	MDPS state display
TPMS	Cluster	C-CAN	TPMS state display
		Hardwire	Out side temp. display

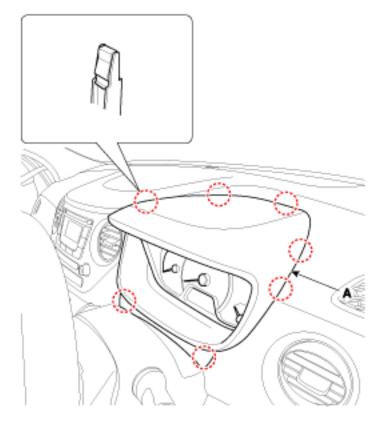
### **REMOVAL**

# **▲** CAUTION

• Put on gloves to protect your hands.

# NOTICE

- When prying with a flat-tip screwdriver, wrap it with protective tape, and apply protective tape around the related parts, to prevent damage.
- Use a plastic panel removal tool to remove interior trim pieces to protect from marring the surface.
- Take care not to bend or scratch the trim and panels.
- 1. Disconnect the negative (-) battery terminal.
- 2. Using a screwdriver or remover, remove the cluster fascia panel (A).



3. Remove the cluster (A) after loosening screws and disconnecting a connector (B).



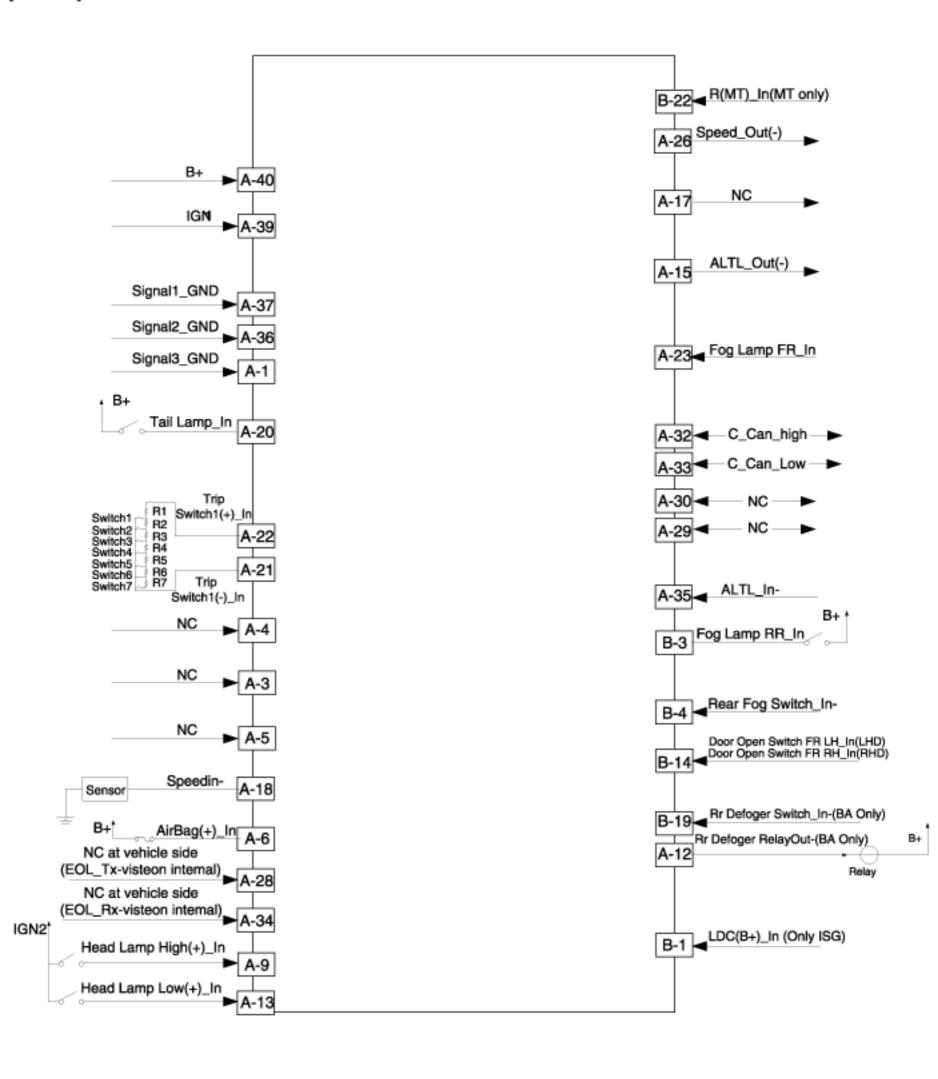


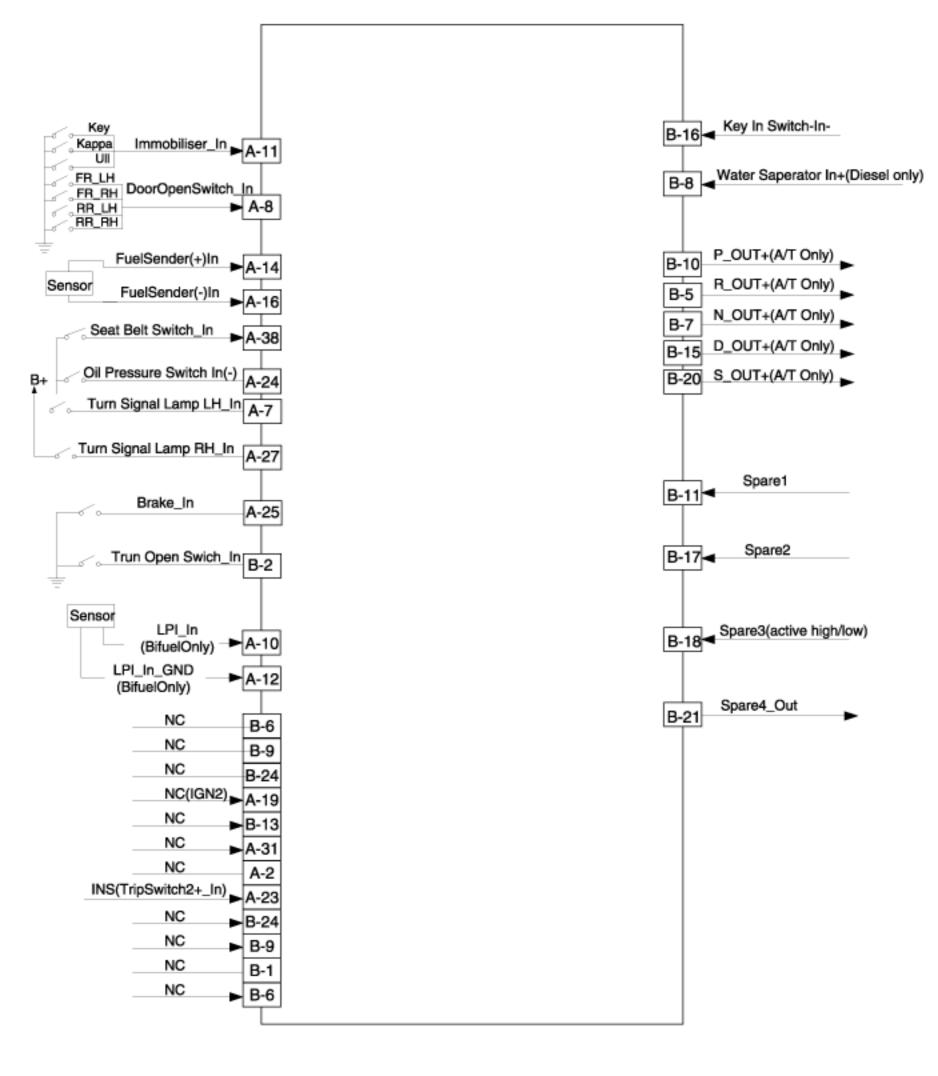
# **INSTALLATION**

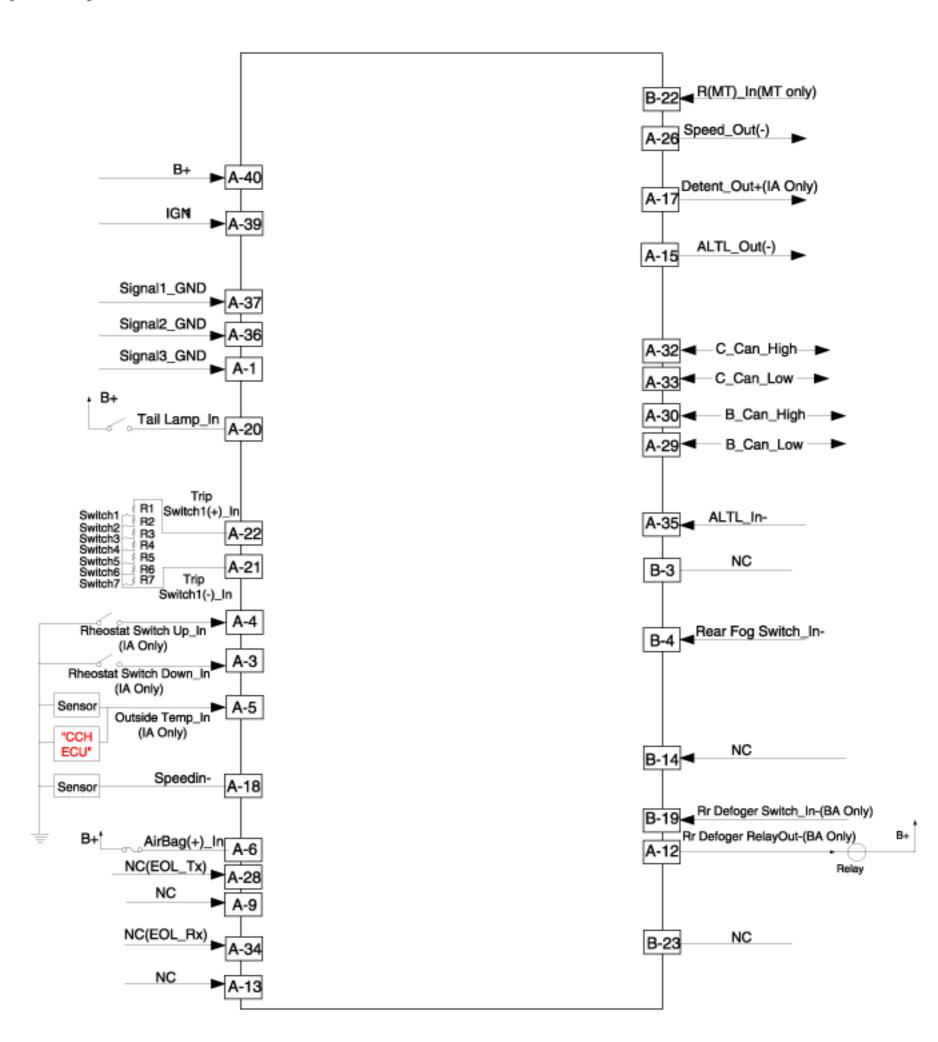
- 1. Install the cluster to the crash pad.
- 2. Install the cluster fascia panel.

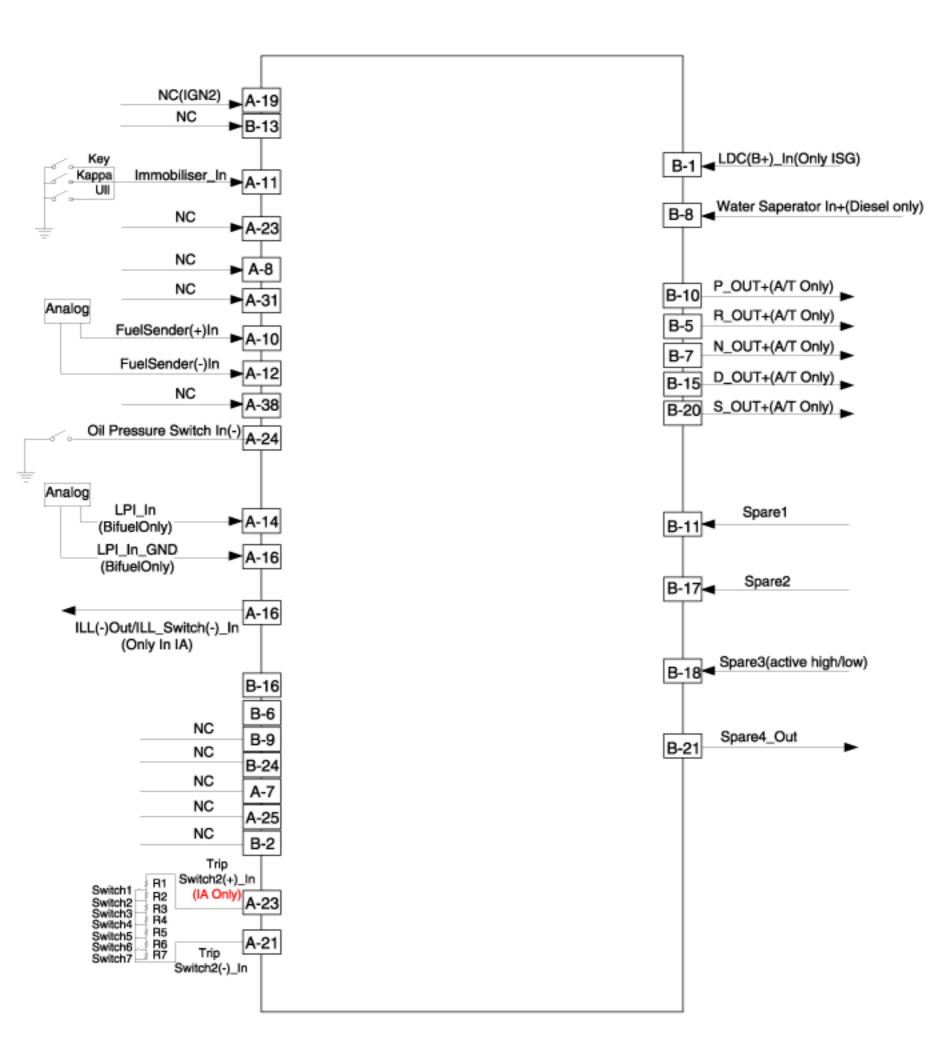
### **CIRCUIT DIAGRAM**

[General]

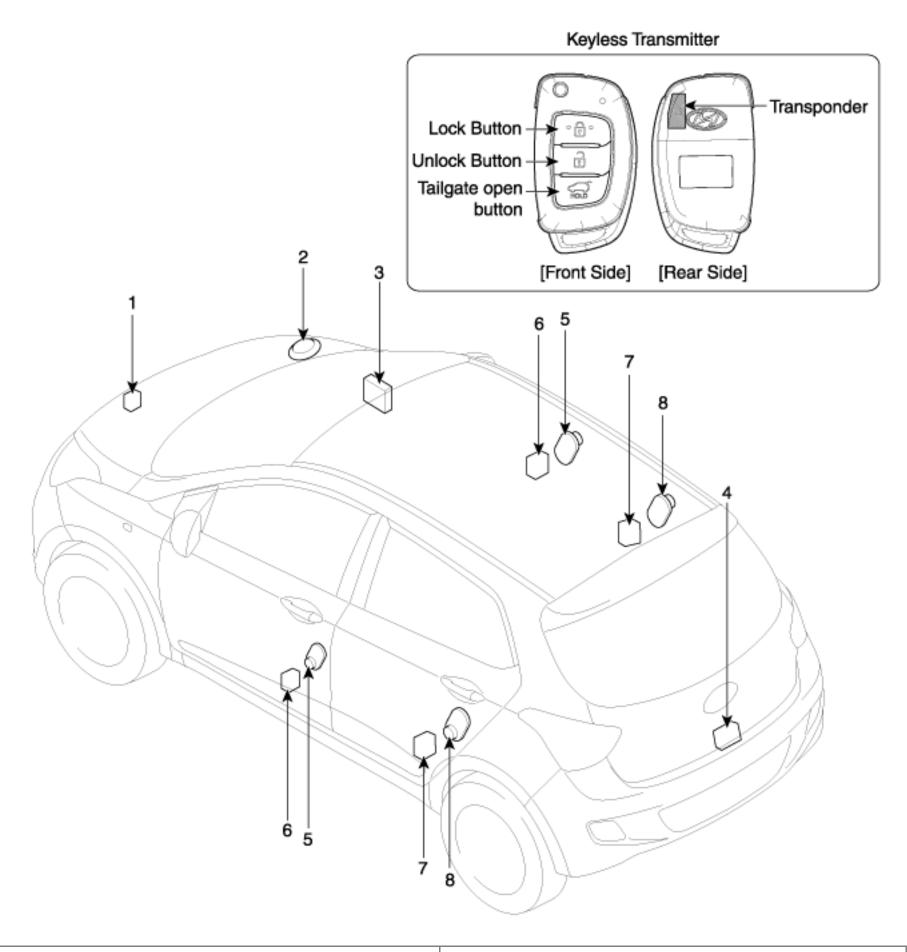








### **COMPONENT LOCATION**



- 1. Hood switch
- 2. Burglar horn
- 3. BCM and RF antenna
- 4. Tailgate open switch
- 5. Front door switch

- 6. Front door lock actuator & switch
- 7. Rear door lock actuator
- 8. Rear door switch

### **DESCRIPTION**

# Burglar Alarm State [B/A State]

B/A State	Description
DISARM	In "DISARM" state, no vehicle start inhibition. So, when door, hood, or Tailgate is opened, there is no alarm sound and flashing.
DISARIVI	2) If the battery is disconnected while the state is not "ARM/ARMWAIT/ALARM/REARM", B/A state is set to "DISARM" state.
4 DA MA/A I T	In "ARMWAIT" state, when timer "30sec." is running, if this timer reaches "30sec", state transits to "ARM" state.
ARMWAIT	2) If the battery is disconnected while the state is "ARMWAIT", B/A state is set to "ARMWAIT" state and timer "30sec" is restarted.

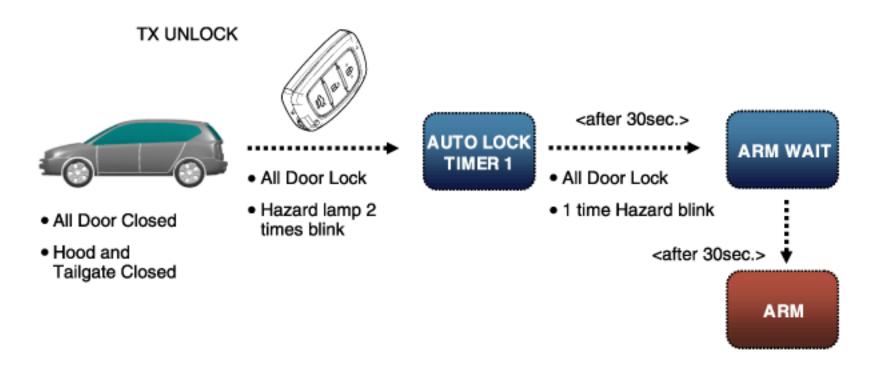
### [ARM WAIT Procedure]



\* Remark: On Smart key system, it works the same way with passive lock

B/A State	Description
	<ol> <li>In "AUTOLOCKTIMER1" state, timer "30sec." is running. If this timer expired, the auto lock command is generated "Lock command".</li> </ol>
	<ol> <li>When "Lock command" operated, All Door changed lock and closed then B/A state changes "AUTOLOCKTIMER1" to "ARMWAIT</li> </ol>
AUTO LOCK TIMER 1	3) In "AUTOLOCKTIMER1" state, Security Indicator keeps blinking. In "AUTOLOCKTIMER1" state, timer "30sec."is running. If this timer expired, the auto lock command is generated "Lock command". When "Lock command" operated, All Door changed lock and closed then B/A state changes "AUTOLOCKTIMER1" to "ARMWAIT

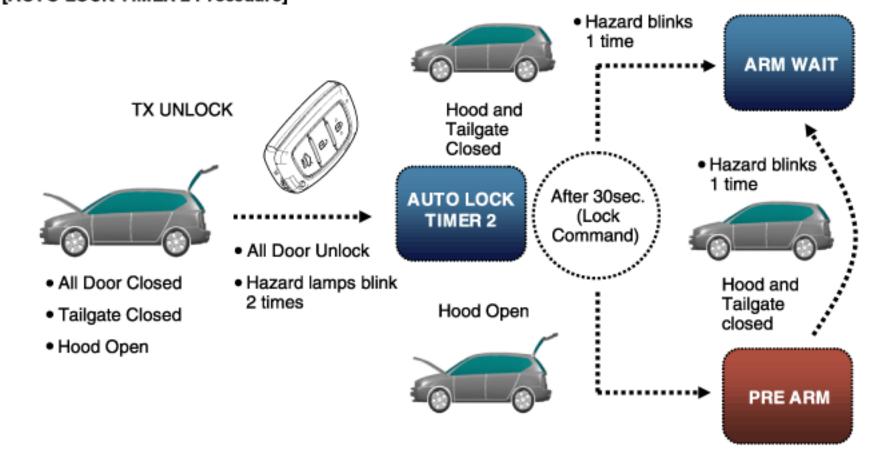
#### [AUTO LOCK TIMER 1 Procedure]



\* Remark: On Smart key system, it works the same way with passive unlock

B/A State	Description
	<ol> <li>In "AUTOLOCKTIMER2" state, when timer "30sec." is running, if this timer expired, the auto lock command is generated "Lock command".</li> </ol>
AUTO LOCK TIMER 2	<ol> <li>All doors are Locked, Hood is closed and Tailgate is closed when "Lock command" operated, then B/A state changes to "AUTOLOCKTIMER2" when "Lock Command" generated with Hood open.</li> </ol>
	<ol> <li>When "Unlock command" operated on the condition of All Door closed and Hood open, B/A state changes to "AUTOLOCKTIMER2".</li> </ol>

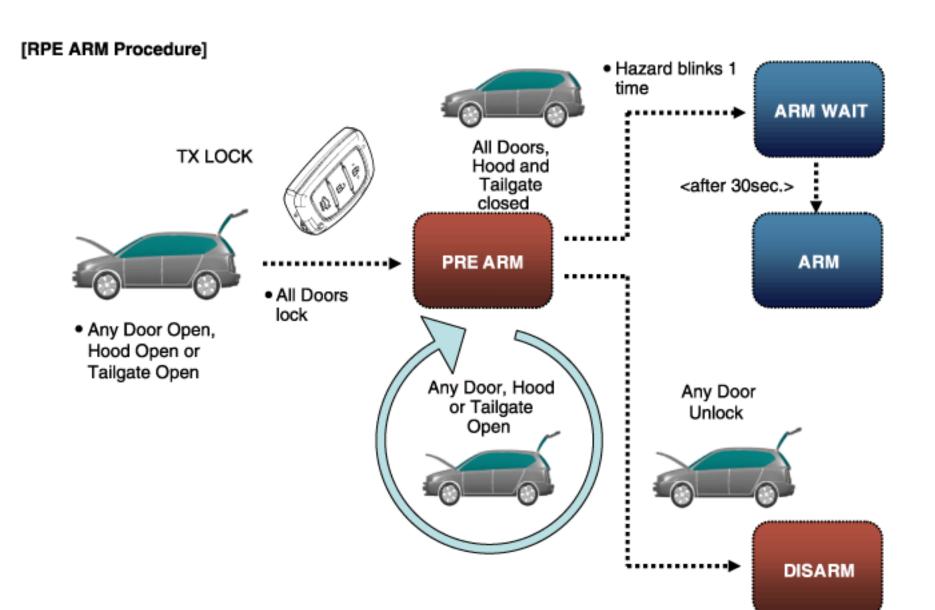
#### [AUTO LOCK TIMER 2 Procedure]



\* Remark: On Smart key system, it works the same way with passive unlock

B/A State	Description
DIA State	Description

	<ol> <li>The "PREARM" state is when user try to change to arm but pre-condition are not satisfied (door open, tailgate open, or hood open).</li> </ol>
	<ol> <li>B/A state changes to "PREARM" when TX Lock command occurs with any door Open, Hood or Tailgate Open.</li> </ol>
PRE ARM	<ol> <li>B/A state changes to "PREARM" when "30sec." timer expired in "AUTOLOCKTIMER2" with Hood or Tailgate Open</li> </ol>
	4) The "PREAMR" state changes to "ARM" when all doors closed, All doors locked and Hood and Tailgate closed.
	5) The "PREAMR" state changes to "DISARM" when Any Door Unlock

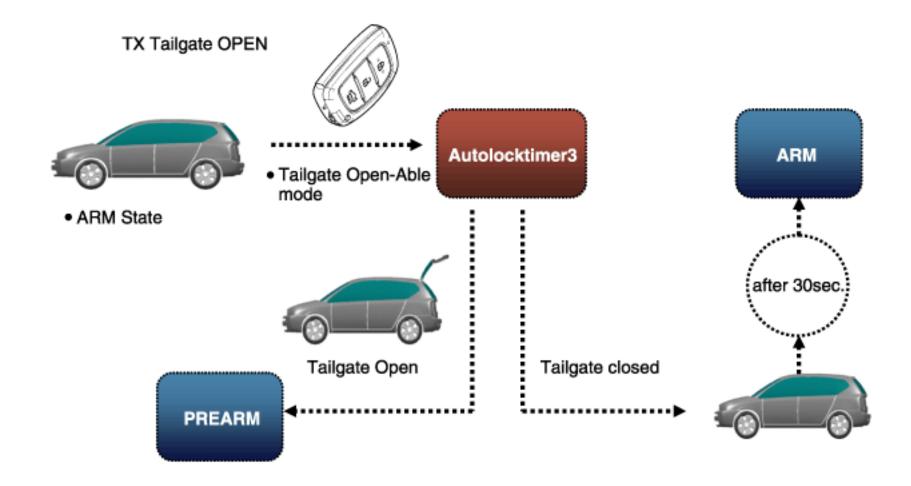


B/A State	Description
RE ARM	In "REARM" state, if the vehicle intrusion is detected, flashing and sound is restarted, again and state transits to "ALARM" state.
	2) B/A state changes to "REARM" after the timer "27sec." expires in "ALARM" state with All doors closed and lock.

B/A State	Description
	1) B/A state changes to "AUTOLockTIMER3", when TX-Tailgate command operated.
	<ol> <li>B/A state changes "AUTOLOCKTIMER3" to "ARMWAIT", when the "30sec." timer expires with all doors lock and closed.</li> </ol>
AUTOLOCK TIMER3	3) B/A state changes "AUTOLOCKTIMER3" to "DISARM", when any door open.
	4) In "AUTOLOCKTIMER3" state, timer "30sec." timer is running. If this timer expired,

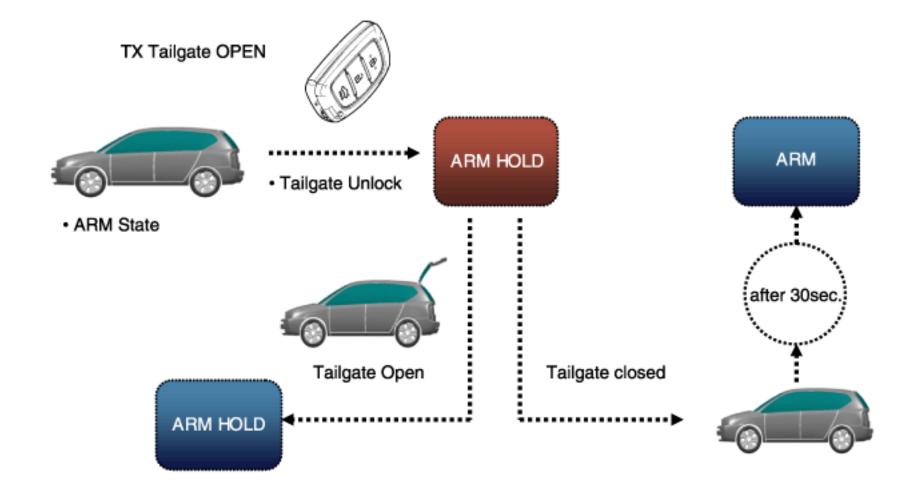
state transits to "PREARM" state with Tailgate Open.

# [AUTOLOCKTIMER 3 Procedure]



B/A State	Description
	1) The ARM HOLD mode is similar to the trunk alarm hold mode for current cars.
	<ol> <li>If the trunk is opened by a remote controller (including the smart key) in the ARM mode, the Hold mode will be turned on, in which the theft alarm is held for the trunk.</li> </ol>
	3) As long as the trunk is opened, ARM HOLD mode continues.
ARM HOLD (Alarm hold : Trunk)  *Non-PTL option	4) When the trunk is closed, the 30-second timer is activated. Since the ARM HOLD mode is on for 30 seconds, the theft alarm is not issued even though the trunk is opened.
	5) ARM mode is on as soon as 30 seconds after the trunk is closed.
	<ol> <li>Even in ARM HOLD mode, the door and hood are in the ARM mode. They issue alarms normally when a theft occurs.</li> </ol>
	7) The security indicator keeps flickering during ARM HOLD time.

### [ARM HOLD Procedure]



\* Remark 1: ARM HOLD is a function that holds the ARM mode on the trunk. It keeps the ARM mode on the door and hood.

\* Remark 2: When using the ignition key to open the trunk, the ARM HOLD function works in the same way, provided that the "Door Key Burglar Alarm" function should be enabled. if this is disabled, the key-based ARM HOLD is off and using the key to opening the trunk is determined as a theft and the alarm is issued.

B/A State	Description
	If the door, hood and trunk are all closed after the termination of ALARM mode, it means that the ARM mode is on again.
RE ARM (ARM mode is on again)	2) At this time the actuator state (door lock/unlock) is neglected and ARM mode is kept until the remote control signal is received (normal ARM mode).  3) The accurity indicator keeps flickering during this mode.
	The security indicator keeps flickering during this mode.
	1) When the battery is removed in ALARM or RE ARM mode, RESET mode is on.
RESET	<ol> <li>When the battery is installed after RESET, the theft alarm operation resumes.</li> <li>(instead of remained output, 27 seconds ON/10 seconds OFF output in three times</li> </ol>

# Other Theft Alarm System Control Functions

**Item** 

	·
	For non-smart cars, a 30-second standby with the ignition key on during ALARM mode will deactivate the theft alarm status.
KEY ON 30 second deactivation (Non-Smart Key option)	2) Even before 3O seconds pass, if the engine starts (Alternator "L" terminal voltage is HI: sent from the cluster module to CAN data), the theft alarm is instantly deactivated.(no start proposition control: The immobilizer system is applied by default and the engine start by the registered immobilizer key is allowed though during alarming.)  *In a smart key vehicle, the alarm is deactivated instantly after the smart key authentication.

**Description** 

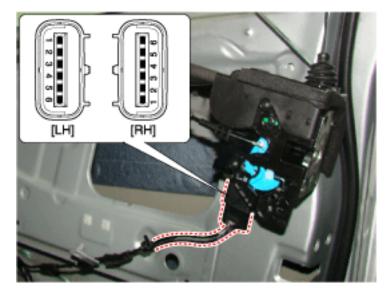
When ARM mode is on, the trunk OPEN and central door unlock are not allowed.

- 1) From the moment that the remote controller or smart key based all door lock is activated and ARM standby mode (ARM WAIT) is on, the central door unlock switch of the indoor trunk unlock switch or DDM & ADM (driver seat power window switch & passenger seat power window switch) is disabled. (theft prevention)
  - \*This function works in the same in ARM WAIT, ARM, ALARM and RE ARM modes.

#### **INSPECTION**

# Door Lock Module Inspection

- Remove the front door trim.
   (Refer to Body "Front Door Trim")
- Remove the front door module. (Refer to Body - "Front Door Module")
- 3. Disconnect the connector from the actuator.

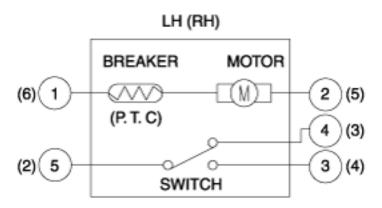


4. Check door module operation by connecting power and ground according to the table. And check the continuity between terminals.

### NOTICE

To prevent damage to the actuator, apply battery voltage only momentarily.

### [5pin Actuator type]



Operation Terminal		Lock	Unlock
	2	$\Theta$	$\oplus$
	1	0	$\Theta$
LH	3 and 4	-	-
	4 and 5	ON → OFF	OFF → ON
	5 and 3	OFF → ON	ON → OFF

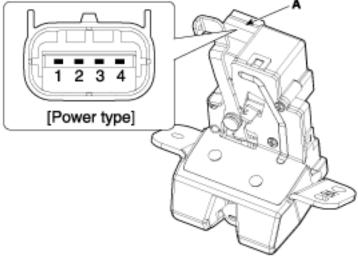
Operation Terminal		Lock	Unlock
	5	$\oplus$	$\ominus$
	6	$\Theta$	$\oplus$
RH	3 and 4	-	-
	2 and 3	ON → OFF	OFF → ON
	2 and 4	OFF → ON	ON → OFF

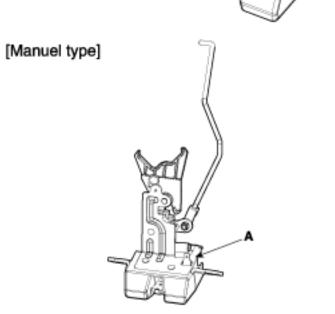
# Tailgate Latch Inspection

- Remove the tailgate trim.
   (Refer to Body "Tailgate Trim")
- 2. Remove the the tailgate latch (A) after loosening the bolts and nuts.



3. Disconnect the tailgate latch connector (A)





4. Check actuator operation by connecting power and ground according to the table. To prevent damage to the actuator,

apply battery voltage only momentarily.

# [Tailgate Latch - Power type]

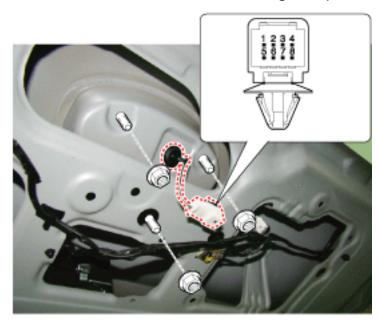
Operation Terminal	Lock ──→ Unlock
4	$\ominus$
3	$\oplus$
2	OFF → ON
1	

# [Tailgate Latch - Manual type]

Operation Terminal	Lock → Unlock	Unlock → Lock	
1	ON	OFF	
GND	ON	OFF	

# **Tailgate Open Switch**

- Remove the tailgate trim.
   (Refer to Body "Tailgate Trim")
- 2) Disconnect the connector from Tailgate open switch.

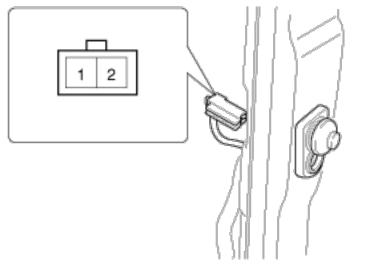


3) Check for continuity between the terminals in each switch position according to the table.

Terminal Position	1	2
OFF		
ON	0	

# **Door Switch Inspection**

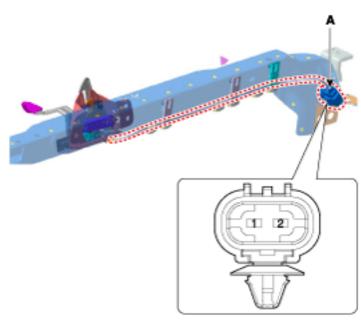
Remove the door switch and check for continuity between the terminals.



Terminal Position	4	2	Body (Ground)
Free(Door open)	$\sim$	$\overline{}$	<b>—</b> ○
Push(Door close)			

# **Hood Switch Inspection**

1. Disconnect the connector from the hood switch (A).

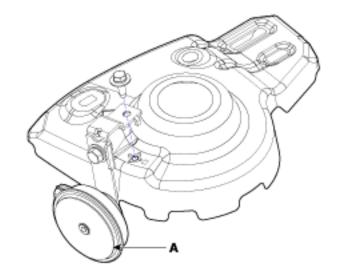


2. Check for continuity between the terminals and ground according to the table.

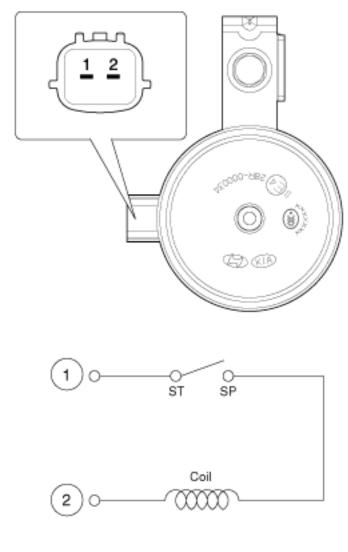
Terminal Position	2	1
Hood open (Free)	0	
Hood close (Push)		

# **Burglar Horn Inspection**

1. Remove the burglar horn (A) after removing 1 bolt and disconnect the connector from the burglar horn.



2. Test the burglar horn by connecting battery power to the terminal 2 and ground the terminal 1.



3. The burglar horn should make a sound. If the burglar horn fails to make a sound replace it.

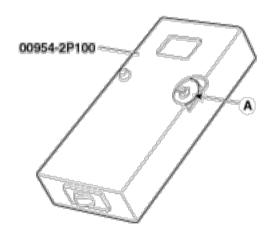
#### **INSPECTION**

- 1. Check that the red light flickers when the door lock or unlock button is pressed on the transmitter.
- 2. Remove the battery (A) and check voltage if the red light doesn't flicker.

Standard voltage: 3V



3. Insert the battery (A) into the tester (09954-2P100).



- 4. Push the test button and If "0.00" is displayed on screen, it means that the battery voltage is 2V or less.
- 5. If "L" is displayed on screen, it means that the battery is low power and it needs to replace.
- 6. To prevent the discharge of electricity, turn the tester power off.
- 7. Replace the transmitter battery with a new one, if voltage is low power then try to lock and unlock the doors with the transmitter by pressing the lock or unlock button five or six times.
- 8. If the doors lock and unlock, the transmitter is O.K, but if the doors don't lock and unlock, register the transmitter code, then try to lock and unlock the doors.
- 9. If the doors lock and unlock, the transmitter is O.K, but if the doors don't lock and unlock, replace the transmitter.

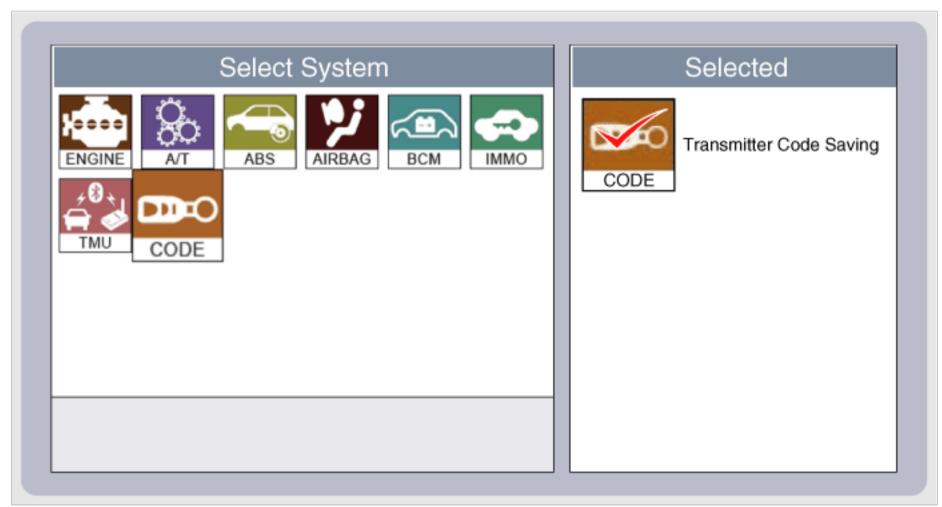
# **▲** WARNING

An inappropriately disposed battery can be harmful to the environment and human health. Dispose the battery according to your local law(s) or regulation.

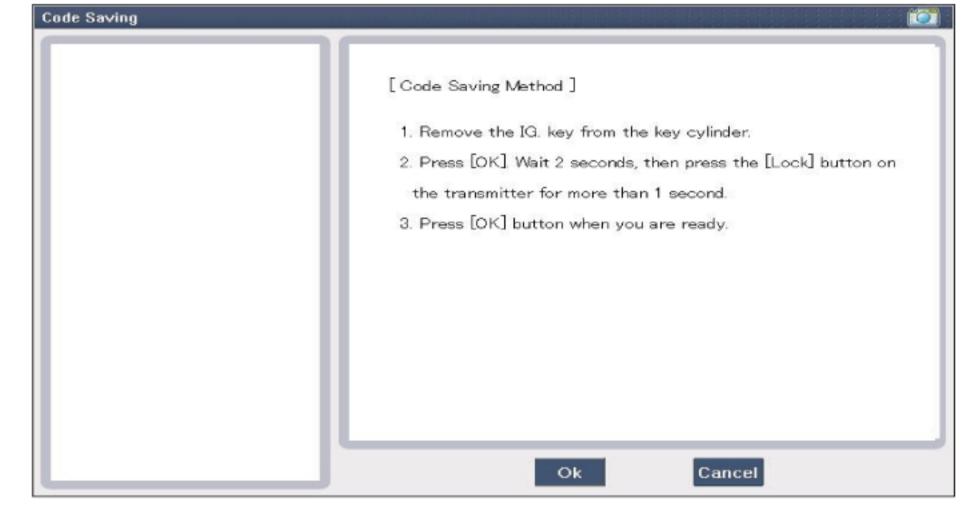
1. Connect the DLC cable of GDS to the data link connector (16 pins) in driver side crash pad lower panel, turn the power on GDS.



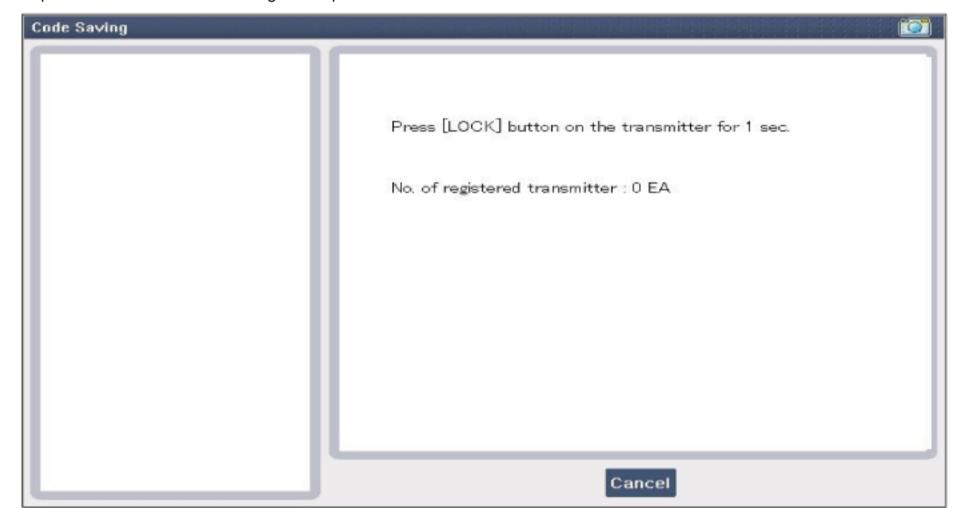
2. Select the vehicle model and then do "CODE SAVING"

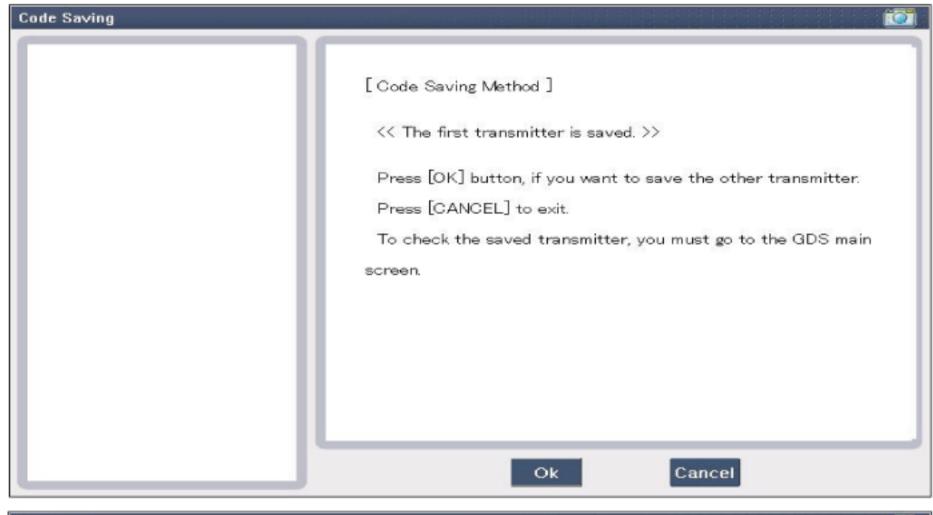


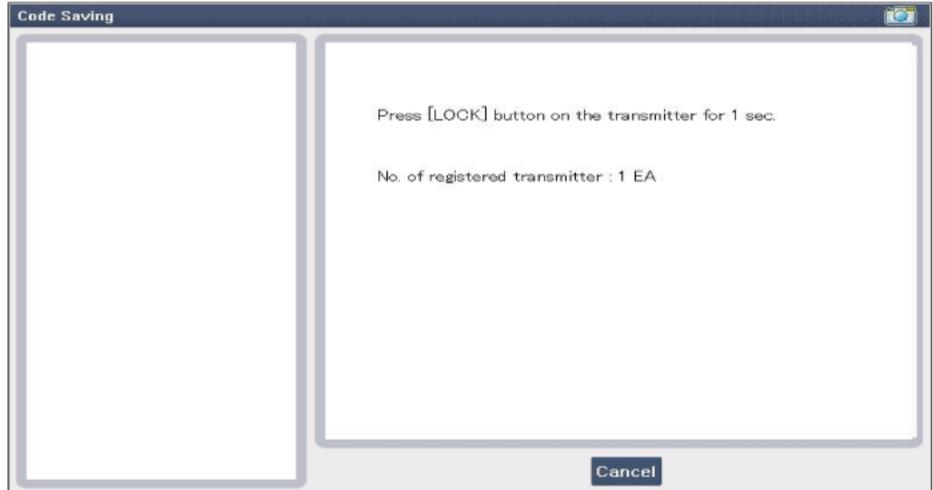
3. After selecting "CODE SAVING" menu, button "ENTER" key, then the screen will be shown as below.

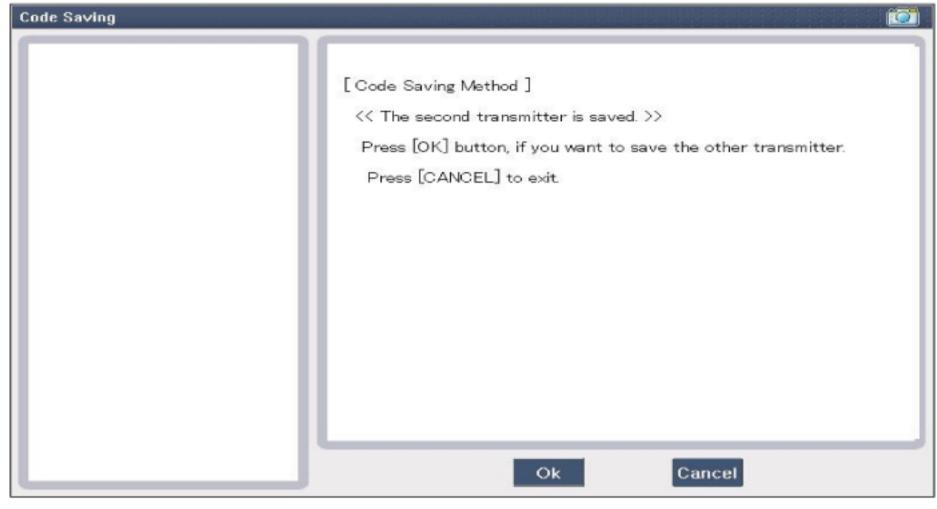


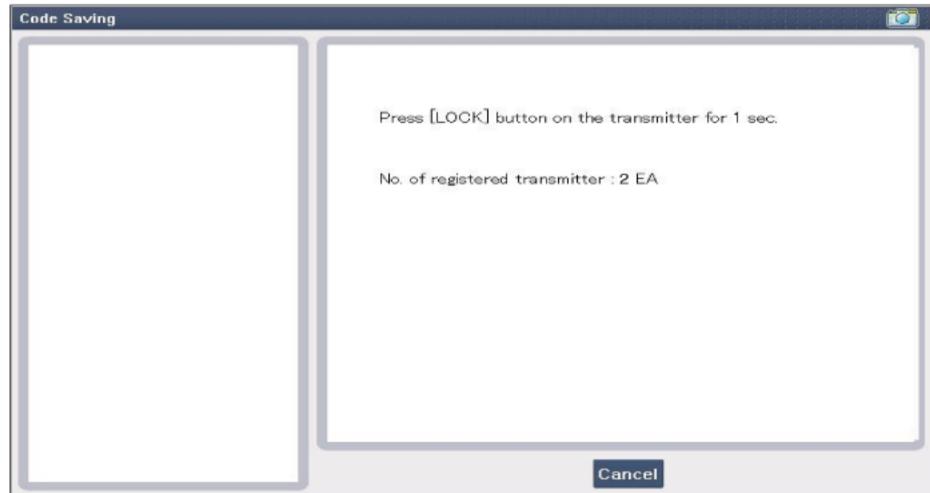
4. After removing the ignition key from key cylinder, push "ENTER" key to proceed to the next mode for code saving. Follow steps 1 to 4 and then code saving is completed.

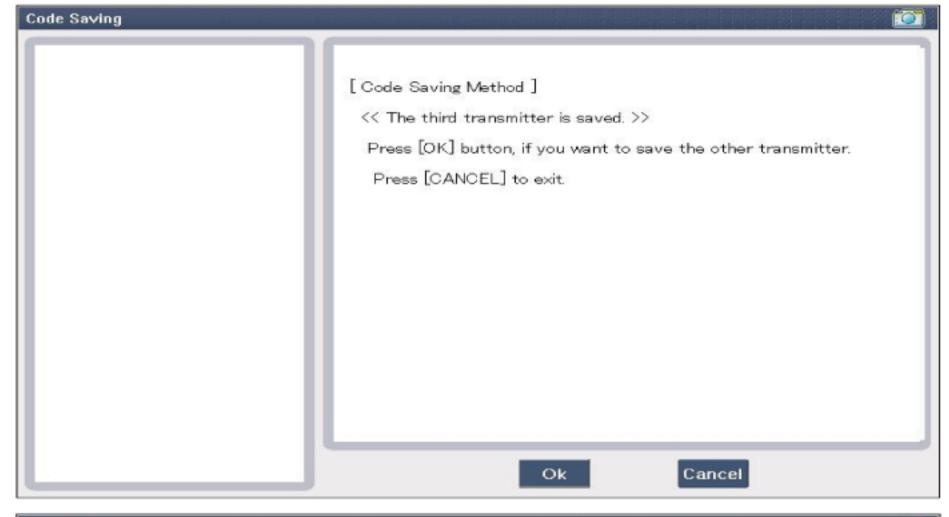


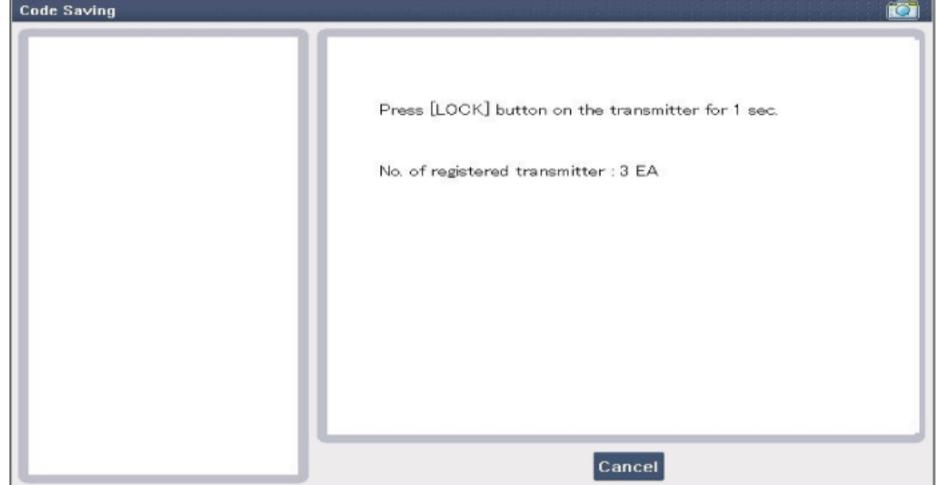


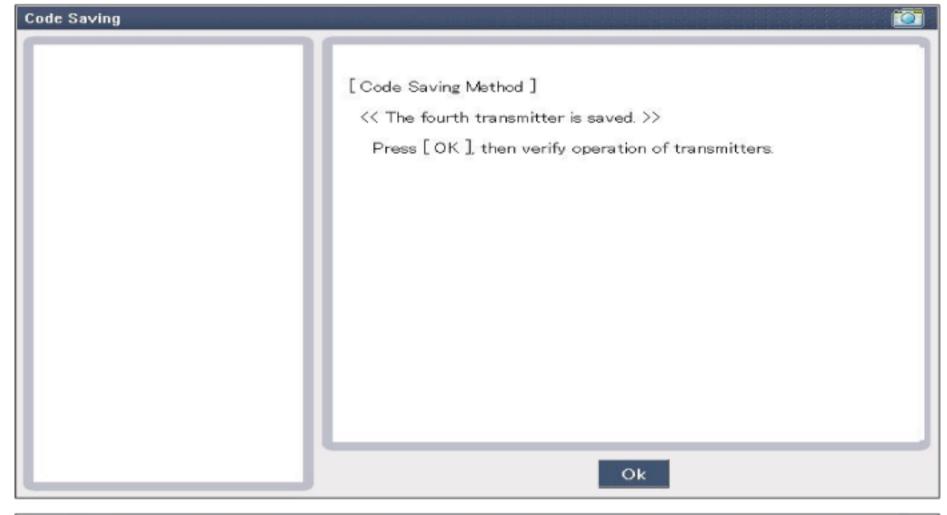


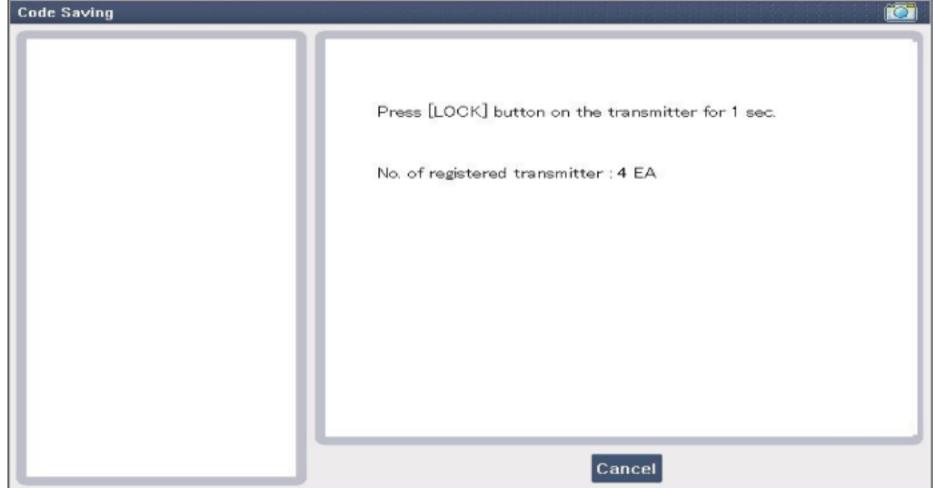








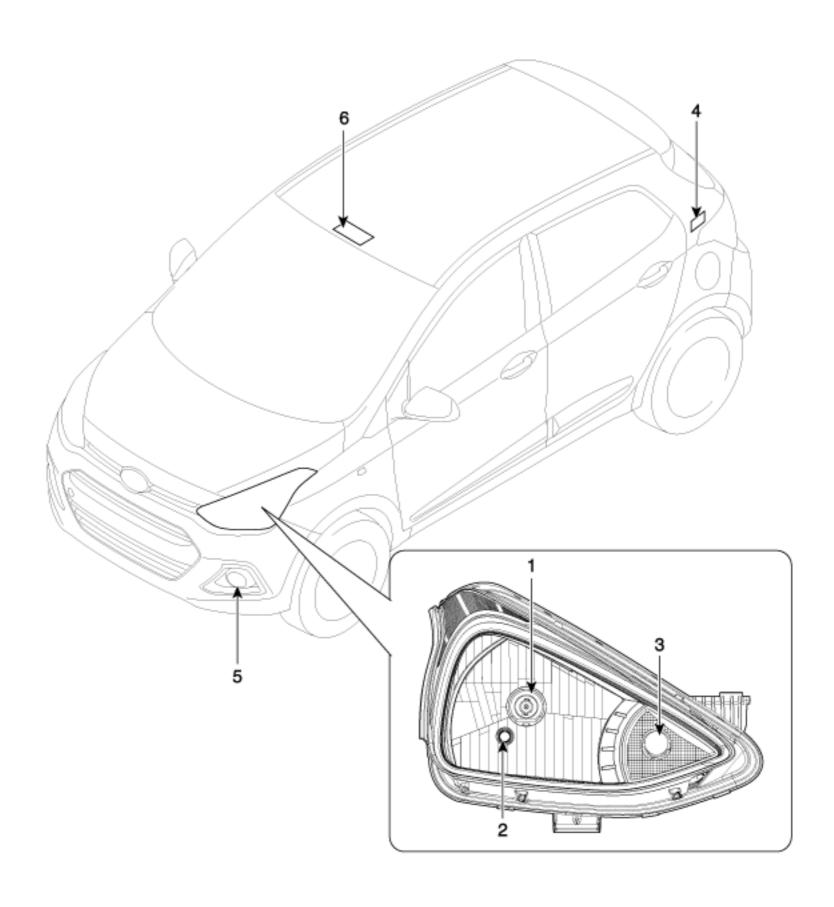




# **SPECIFICATION**

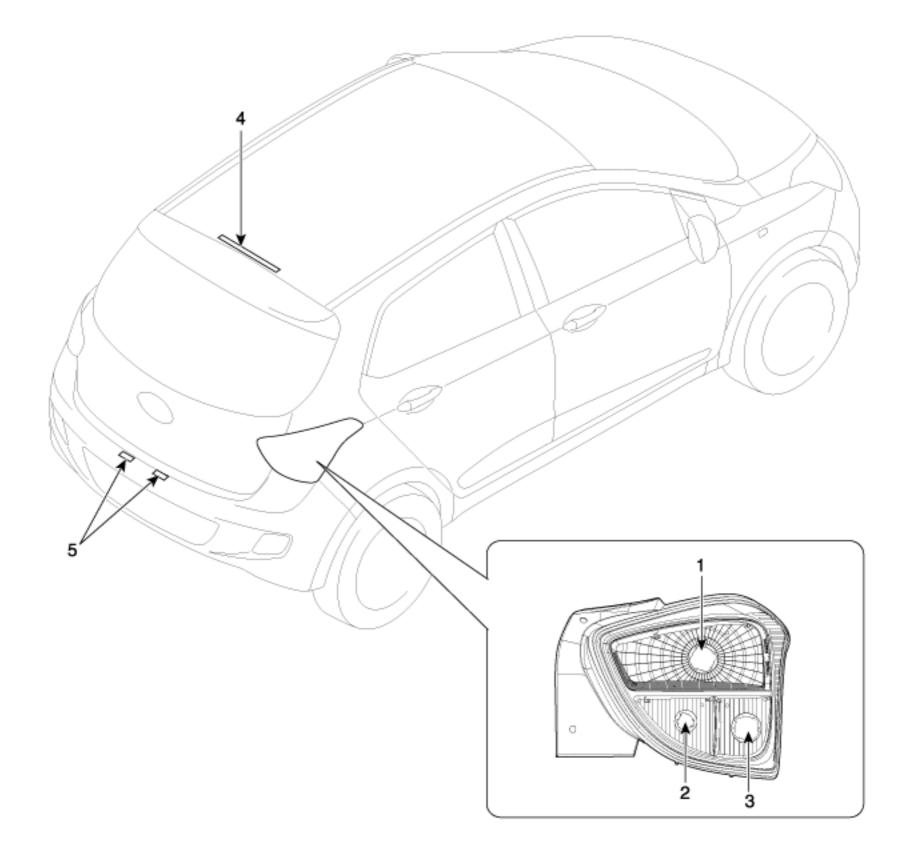
Item	Description
Power source	3V
Operating temperature	-20°C ~ +60°C (-4°F ~ +140°F)
RF frequency	433.92MHz
Battery	CR2032
Transmissible distance	30m or more
Life of battery	2years or more(at 20 times per day)
Button number	3
	Door lock
Function	Door unlock
	Burglar horn

# **COMPONENT LOCATION**



- 1. Head lamp (High/Low)
- 2. Position lamp
- 3. Turn signal lamp

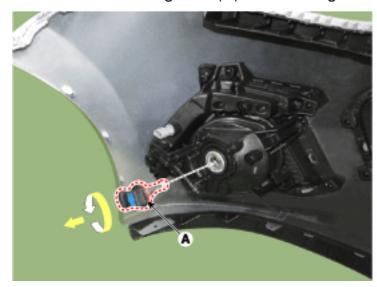
- 4. Luggage lamp
- 5. Front fog lamp
- 6. Room lamp / Map lamp(option)



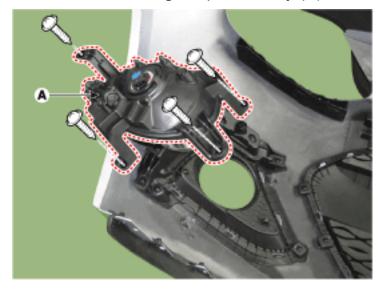
- Tail/stop lamp
   Backup lamp
   Turn signal lamp

- 4. High mounted stop lamp
- 5. License lamp

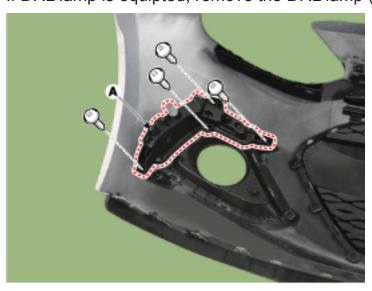
- 1. Disconnect the negative (-) battery terminal.
- Remove the front bumper cover.(Refer to Body "Front Bumper Cover")
- 3. Remove the front fog bulb (A) after turning it counterclockwise.



4. Remove the front fog lamp assembly (A) after loosening 4 screws, if it is necessary.

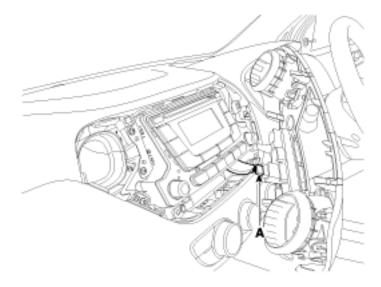


5. If DRL lamp is equipted, remove the DRL lamp (A) after loosening the screws.



- 1. Install the front fog bulb and connect the connect.
- 2. Install the front fog lamp and DRL lamp (option)
- 3. Install the front bumper cover.

- 1. Disconnct the negative (-) battery terminal.
- Remove the center fascia panel.
   (Refer to Body "Center Fascia Panel")
- 3. Disconnect the hazard switch connector (A).

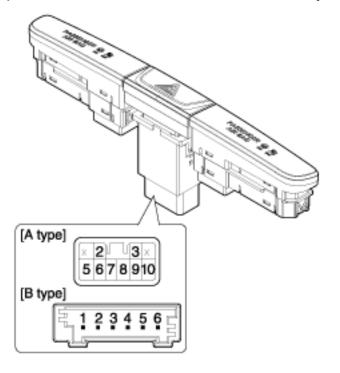


### **INSTALLATION**

- 1. Connect the hazard switch connector and install the center fascia panel.
- 2. Connct the negative (-) battery terminal.

#### **INSPECTION**

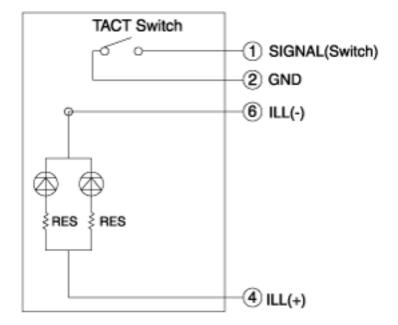
1. Operate the switch and check for continuity between terminals with an ohmmeter.



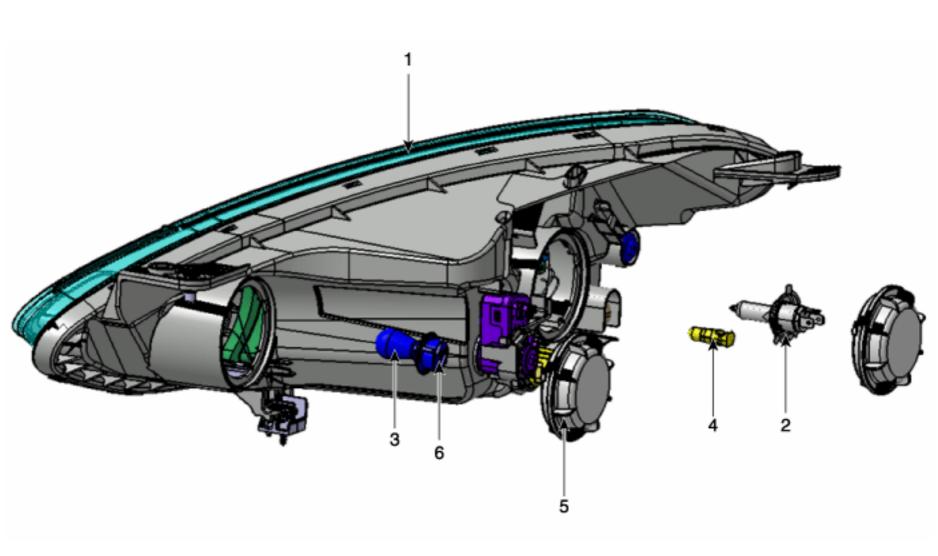
A type

Position Terminal	OFF (FREE)	(LOCK)	Remarks
5	07		IGN
7		0	Battery
8	0	0	Common
6		0	F MATT
10		0	RH
9		0	LH
2	0	~~~	Illumination(+)
3	0-	Ψ	Illumination(-)

# B type



## COMPONENT



- 1. Head lamp assembly lens & housing
- 2. Head lamp low / high bulb
- 3. Turn signal lamp bulb

- 4. Position lamp bulb
- 5. Dust cap
- 6. Bulb socket

- 1. Disconnect the negative (-) battery terminal.
- Remove the front bumper cover.(Refer to Body "Front Bumper Cover")
- 3. Loosening the head lamp mounting bolts and disconnect the head lamp connector (B). Then, remove the head lamp assembly (A).

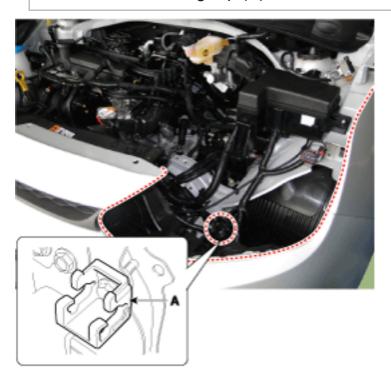
## NOTICE

Take care not to scratch the head lamp lens or fender.



## NOTICE

Take care that holding clip (A) is not to be damaged.



- 1. Install the head lamp bulbs.
- 2. Connect the connectors.
- 3. Install the head lamp with the head lamp bolts (3EA).
- 4. Connect the negative (-) battery terminal.

#### **HEAD LAMP AIMING INSTRUCTIONS**

The head lamps should be aimed with the proper beam-setting equipment, and in accordance with the equipment manufacturer's instructions.

#### NOTICE

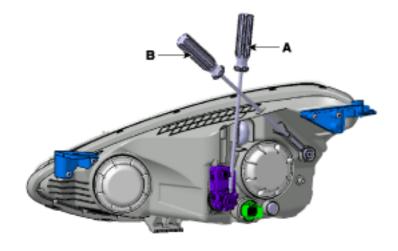
If there are any regulations pertinent to the aiming of head lamps in the area where the vehicle is to be used, adjust so as to meet those requirements.

Alternately turn the adjusting gear to adjust the head lamp aiming. If beam-setting equipment is not available, proceed as follows:

- 1. Inflate the tires to the specified pressure and remove any loads from the vehicle except the driver, spare tire, and tools.
- 2. The vehicle should be placed on a flat floor.
- 3. Draw vertical lines (Vertical lines passing through respective head lamp centers) and a horizontal line (Horizontal line passing through center of head lamps) on the screen.
- 4. With the head lamp and battery in normal condition, aim the head lamps so the brightest portion falls on the horizontal and vertical lines.

A: Vertical (Low/High)

B: Horizontal (Low/High)

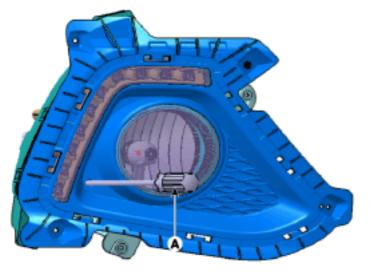


### Front Fog Lamp Aiming

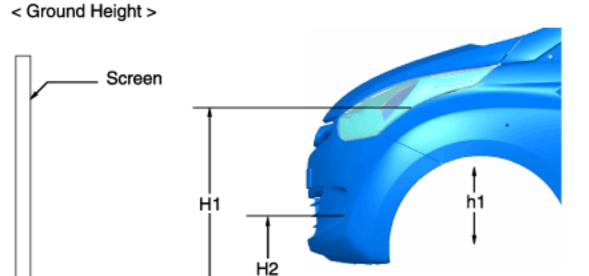
The front fog lamps should be aimed as the same manner of the head lamps aiming.

With the front fog lamps and battery normal condition, aim the front fog lamps by turning the adjusting screw (A) with a driver.

#### [Fog]



## Head Lamp And Fog Lamp Aiming Point



< Distance between lamps >



Ground

H1: Height between the head lamp bulb center and ground (Low/High beam)

H2: Height between the fog lamp bulb center and ground

W1: Distance between the two head lamp bulbs centers (Low/High beam)

W2 : Distance between the two fog lamp bulbs centers

L : Distance between the head lamp bulb center and screen

#### **Head Lamp(Europe)**

Unit: in (mm)

Vehicle condition	H1	W1	L
Without driver	29.3(745)	48.6(1,234)	Refer to aiming condition

#### Fog Lamp(Europe)

Unit: in (mm)

Vehicle condition	H2	W2	L
Without driver	15.1(385)	50.3(1,279)	Refer to aiming condition

### **Head Lamp(General)**

Unit: in (mm)

Vehicle condition	H1	W1	L	
Without driver	30.1(764)	48.6(1,234)	Refer to aiming condition	

Unit: in (mm)

Vehicle condition	H2	H2 W2	
Without driver	16.2(411)	50.1(1,274)	Refer to aiming condition

#### Fog Lamp (General - 35w)

Unit: in (mm)

Vehicle condition	H2	W2	L	
Without driver	16.0(407)	50.3(1,277)	Refer to aiming condition	

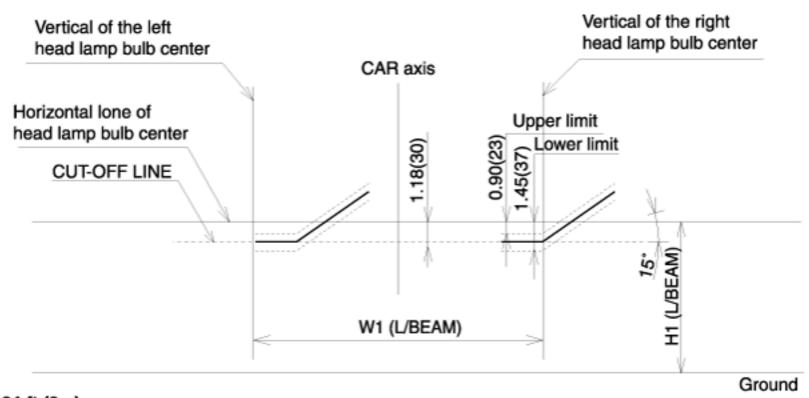
1. Turn the low beam on without driver seated in the vehicle.

The cut-off line should be projected in the allowable range shown in the picture.

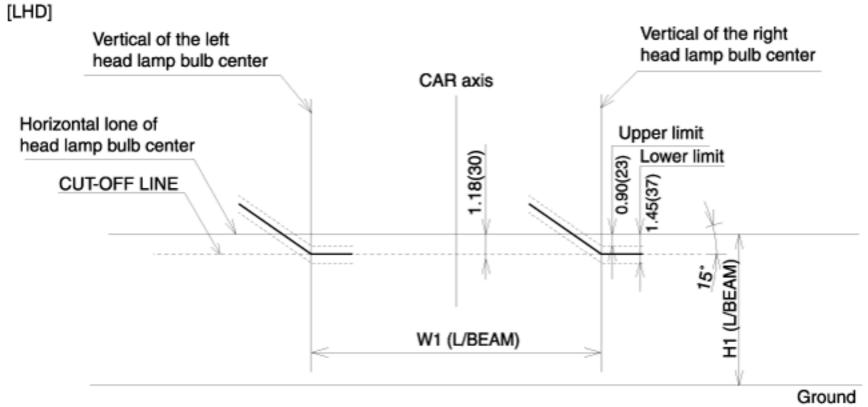
In case of equipping with the manual leveling device, set the leveling device switch on the "O" position.

In case of equipping with the auto leveling device, set the initialization by using the diagnostic tool before aiming.

### [RHD]



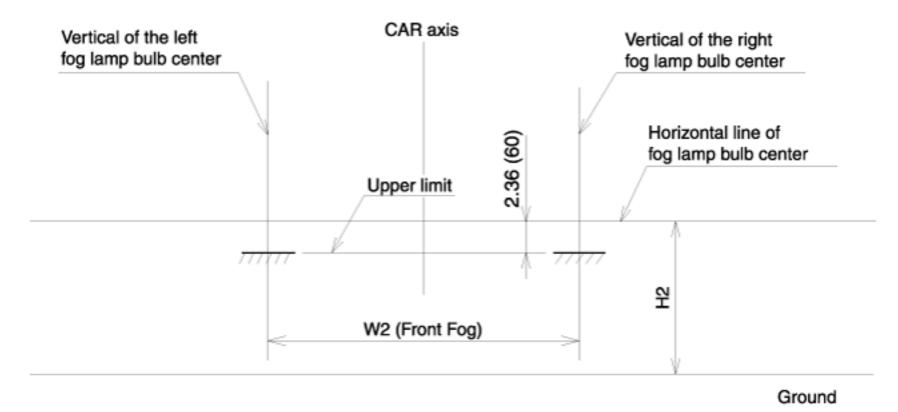
L : 9.84 ft (3m) Unit : in.(mm)



L : 9.84 ft (3m) Unit : in.(mm)

2. Turn the front fog lamp on without driver seated in the vehicle.

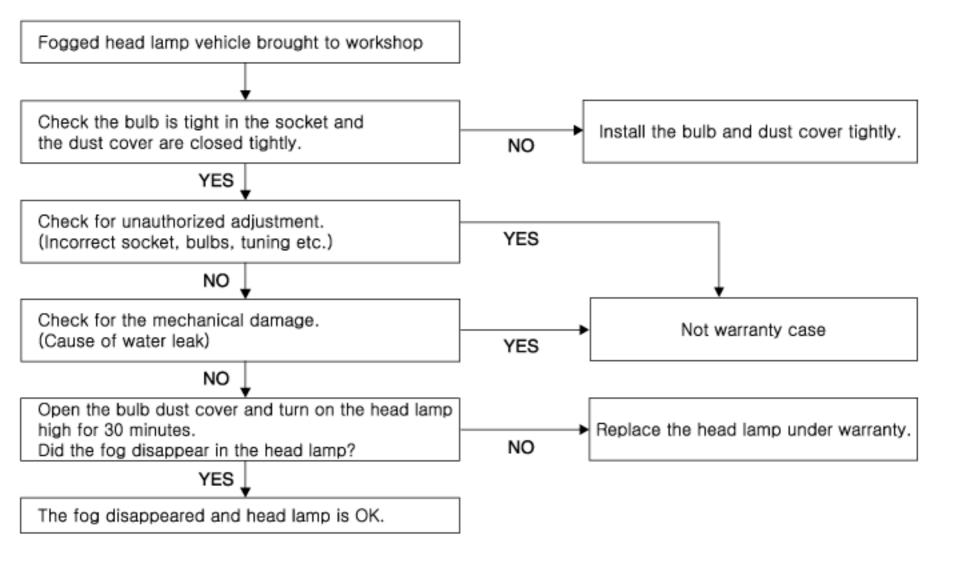
The cut-off line should be projected in the allowable range shown in the picture.



L : 9.84 ft (3m) Unit : in.(mm)

## Head lamp fogging

Check the below instruction procedure when the head lamp is fogged.



#### REPLACEMENT

### Head lamp (Low/High)

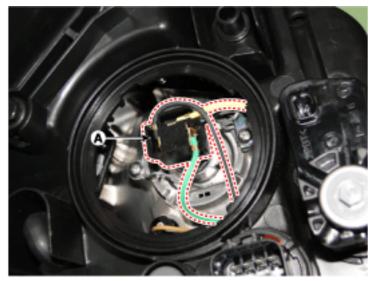
- 1. Turn the lamp switch off.
- 2. Remove the dust cap (A).



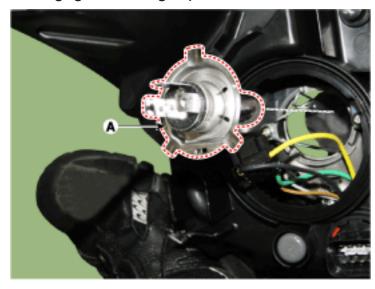
3. Remove the position lamp bulb (A).



4. Disconnect the bulb socket connector (A).



5. Disengage the fixing clip and remove the head lamp (Low/High) bulb (A)



6. Installation is the reverse of removal.

## Turn signal lamp

- 1. Turn the lamp switch off.
- 2. Turn the bulb socket (A) counterclockwise and remove it from head lamp assembly.



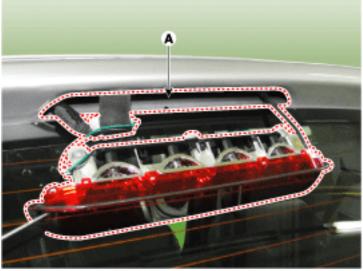
3. Remove the turn signal lamp bulb (A) from socket (B).



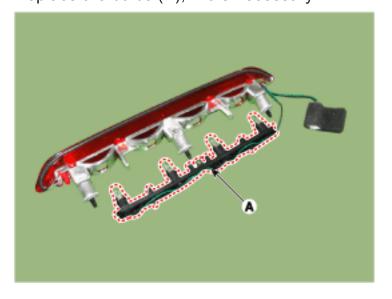
4. Installation is the reverse of removal.

- 1. Disconnect the negative (-) battery terminal.
- 2. Open the tailgate.
- 3. Remove the high mounted stop lamp (A) after removing the mounting nuts.





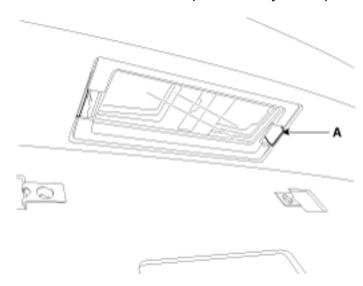
4. Replace the bulbs (A), if it is necessary.



## **INSTALLATION**

- 1. Install the high mounted stop lamp.
- 2. Connect the negative (-) battery terminal.

- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the license lamp assembly after pushing the fixing clip (A).



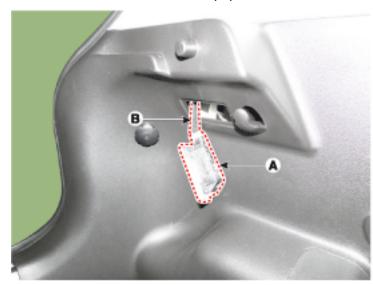
3. Replace the bulb after turning the bulb socket (A) counterclockwise.



## **INSTALLATION**

- 1. Install the bulb and connect the connector.
- 2. Install the license lamp.

- 1. Disconnect the negative (-) battery terminal.
- 2. Using a screwdriver or remover, remove the luggage lamp (A).
- 3. Disconnect the connector (B).



4. Replace the luggage room lamp bulb in case of necessity.

## **INSTALLATION**

- 1. Install the luggage lamp.
- 2. Connect the negative (-) battery terminal.

- 1. Disconnect the negative (-) battery terminal.
- 2. If necessary to replace the bulb only, replace the bulb after opening the overhead console lens (A).



3. Loosen 2 screws holding the overhead console (A).



4. Disconnect the connectors (A) of sunroof switch and lamp switch then remove the overhead console lamp assembly.



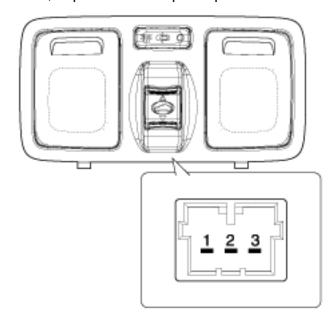
### **INSTALLATION**

1. Install the overhead console lamp after connecting the lamp connector.

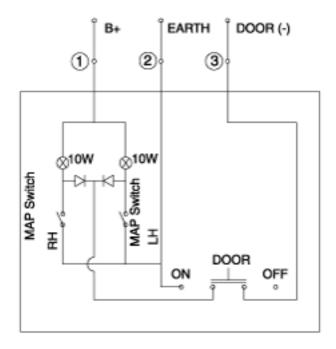
2. Install the lens after tightening screws.

## **INSPECTION**

1. Remove the overhead console lamp assembly then check for continuity between terminals. If the continuity is not as specified, replace the map lamp switch.



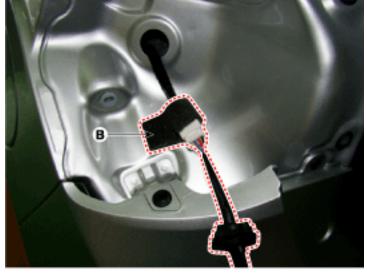
No.	Description
1	Battery(+)
2	Ground(-)
3	Door(-)



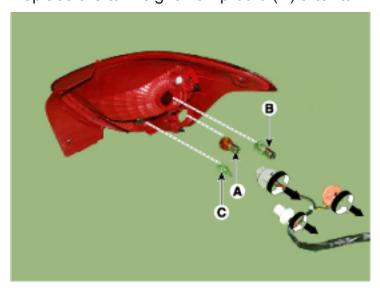
## **Rear Combination Lamp**

- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the rear lamp assembly (A) after removing the screws and connector (B).





3. Replace the turn signal lamp bulb (A) after turning the socket counterclockwise.



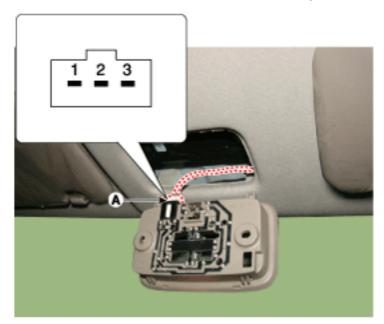
#### **INSTALLATION**

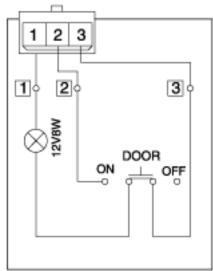
1. Install the rear combination lamp assembly.

### **INSPECTION**

### **Room Lamp**

1. Check that the switch operates properly after disconnecting the room lamp connector (A).





Terminal Position	1	2	3
ON	0—@	<del></del>	
DOOR	0		<u> </u>
OFF			

### **REMOVAL**

### **Room Lamp**

- 1. Disconnect the negative(-) battery terminal.
- 2. Carefully remove the lamp lens (A) from the room lamp with a flat-tip screwdriver.
- 3. Replace the bulbs (B) and remove the screws if it is necessary.



4. Remove the room lamp assembly (A) after disconnecting the connector (B).



## **INSTALLATION**

## Room Lamp

- 1. Reconnect the connector.
- 2. Install the room lamp assembly.
- 3. Install the lens.

## **SPECIFICATION**

## General

ltem		Туре	Watt (W)
	Low	H4	55
Hood Jomn	High	H4	60
Head lamp	Turn signal	PY21W	21
	Position	W5W	5
Foglows	Front(27W)	881	27
Fog lamp	Front(35W)	H8	35
	Stop/Tail (Outside)	21/5WL	21/5
Rear combination lamp	Turn signal	PY21W	21
	Backup	16W	16
Rear fog lamp	Rear	21W	21
Interior	Room lamp	8W	8
High mounted st	op lamp (HMSL)	W5WL	5
Side repeater lamp		W5W	5
Licens	e lamp	W5WL	5
Luggag	ge lamp	8W	8

## Europe

Item		Type	watt (w)
	Low	H4L	55
	High	H4L	60
Head lamp	SBL (option)	H7L	55
	Turn signal	PY21WL	21
	Position	W5WL	5
DRL	Bulb	P21/5WL	21
DRL	LED (option)	1W *10EA	10W
Fog lamp	amp Front (option) H8		35
	Stop/Tail (Outside)	21/5WLL	21/5
Rear combination lamp	Turn signal	PY21WL	21
	Backup	16W	16
Rear fog lamp	Rear	21W	21
Interior	Room lamp	8W	8
interior	Map lamp (option)	10W	10
High mounted st	op lamp (HMSL)	W5W	5
Side repeater lamp		W5W	5

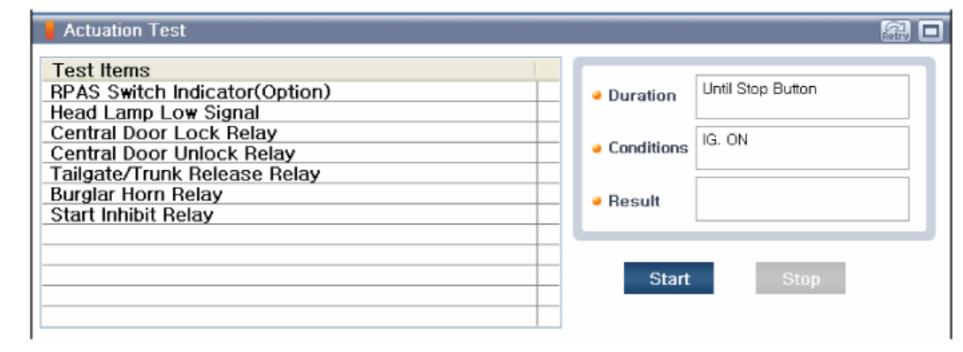
License lamp	W5W	5	
Luggage lamp	8W	8	

#### **TROUBLESHOOTING**

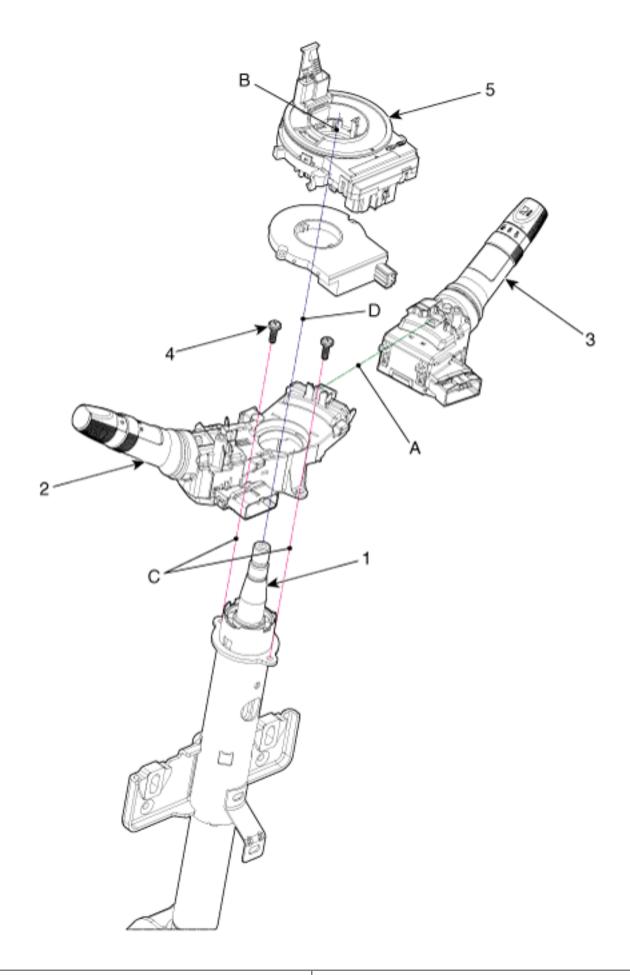
- 1. The lamp switch inputs can be checked using the GDS.
- 2. To check the input value of lamp switch, select option "Body Control Module".
- 3. To consult the present input/output value of BCM, "Current DATA". It provides information of BCM input/output conditions of power supply, turn signal/brake lamp, headlamp, door, locks, outside mirror, wiper, auto-light and transmitters etc.



4. To check the input value of lamp switch in force mode, select option "Actuation Test".

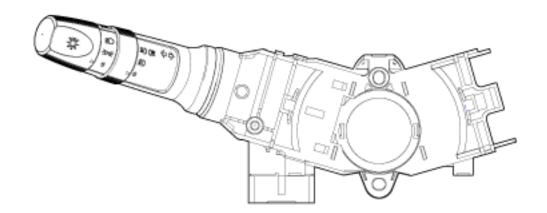


# **COMPONENTS (1)**



- 1. Steering column
- 2. Lighting switch
- 3. Wiper and washer switch

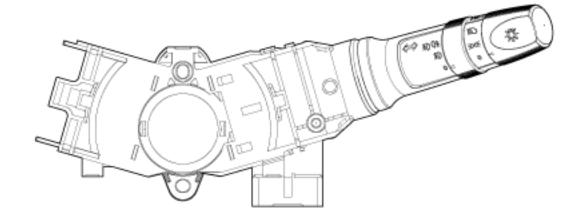
- 4. Screw
- 5. Clock spring



1	2	3			4	5	6
7	8	9	10	11	12	13	14
			(LF	ID)			

NO	CIRCUIT	DESCRIPTION
1	B+	Head Lamp Switch Power
2	EL	Head Lamp Switch Earth
3	HU	Head Lamp Hi Beam Power
4	HL	Head Lamp Low Beam Power
5	TS	Tail Lamp Switch
6	F	Rear Fog Lamp (Head Lamp On Signal)
7	EF	Fog Switch Earth
8	FF	Front Fog Lamp Switch
9	RF	RR Fog Lamp Switch
10	-	-
11	-	-
12	TL	Turn Signal LH Lamp Switch
13	TB	Flash Unit Power
14	TR	Turn Signal RH Lamp Switch

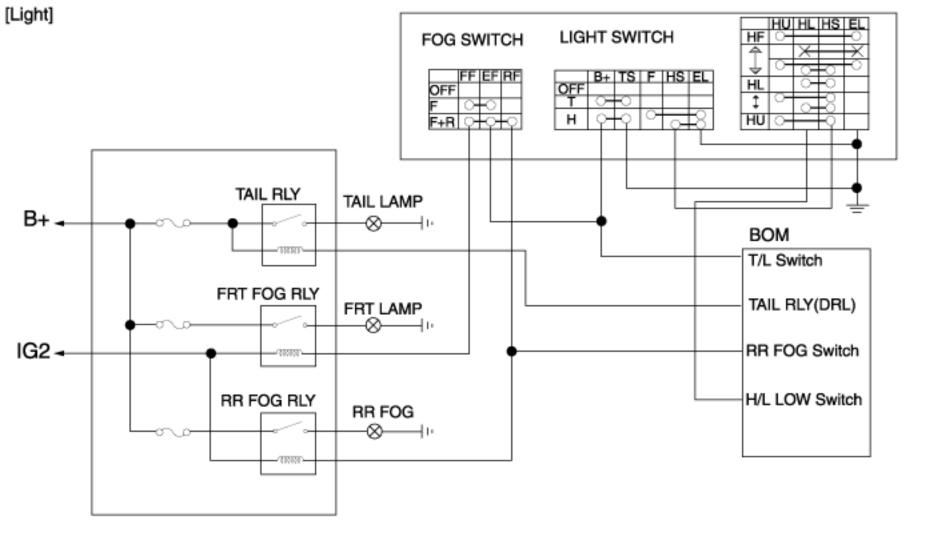
# [Turn Signal Lamp RHD]



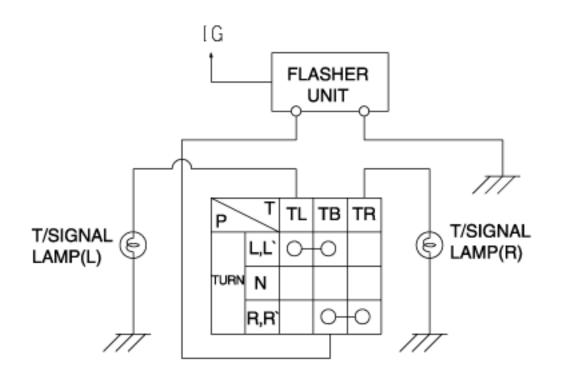
6	5	4			3	2	1
10	11	12	NC	NC	7	8	9
(RHD)							

NO	CIRCUIT	DESCRIPTION
1	B+	Head Lamp Switch Power
2	EL	Head Lamp Switch Earth
3	HU	Head Lamp Hi Beam Power
4	HL	Head Lamp Low Beam Power
5	TS	Tail Lamp Switch
6	F	Rear Fog Lamp (Head Lamp On Signal)
7	EF	Fog Switch Earth
8	FF	Front Fog Lamp Switch
9	RF	RR Fog Lamp Switch
10	TL	Turn Signal LH Lamp Switch
11	TB	Flash Unit Power
12	TR	Turn Signal RH Lamp Switch

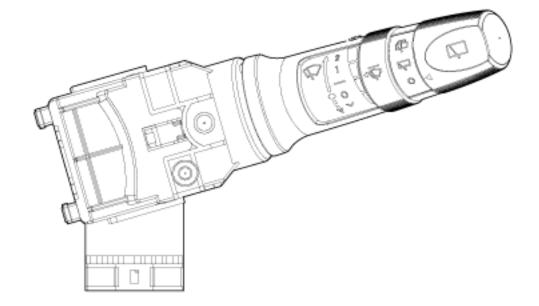
# **CIRCUIT DIAGRAM**



[Turn signal]



# [Wiper and washer (LHD)]



1	3	2	4	5	6	7
8	9	10	11	12	13	14

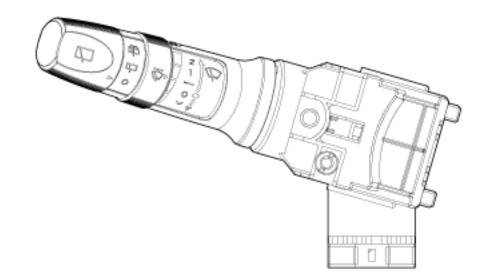
# LHD (UP Type)

1	2	3	4	5	6	7
8	9	10	11	12	13	14

LHD (DOWN Type)

NO	CIRCUIT	DESCRIPTION
1	EW	Wiper GND
2	HI	Wiper HI speed
3	IG2(1)	Wiper & washer & mist power
4	LO	Wiper LOW speed
5	S+	Wiper parking
6	WA	Front washer
7	-	-
8	-	-
9	-	-
10	-	-
11	RP	Rear parking
12	RWA	Rear washer
13	RS	Rear wiper
14	IG2(2)	Rear wiper & washer power

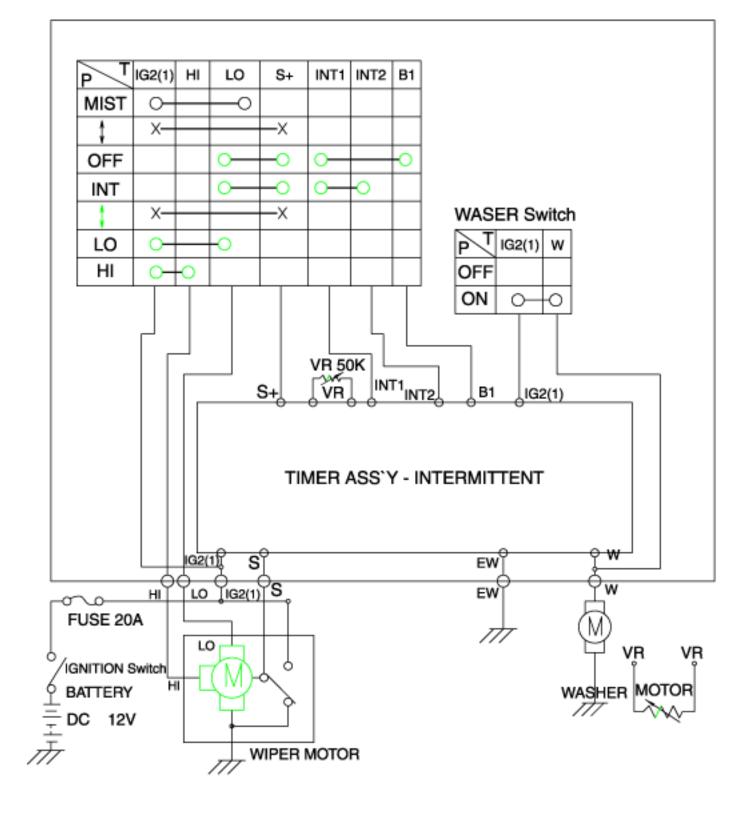
# [Wiper and washer (RHD)]

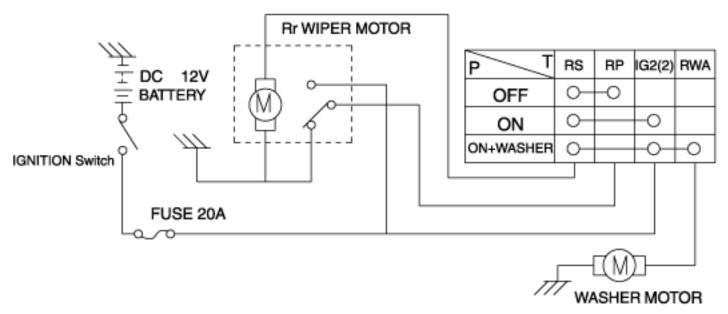


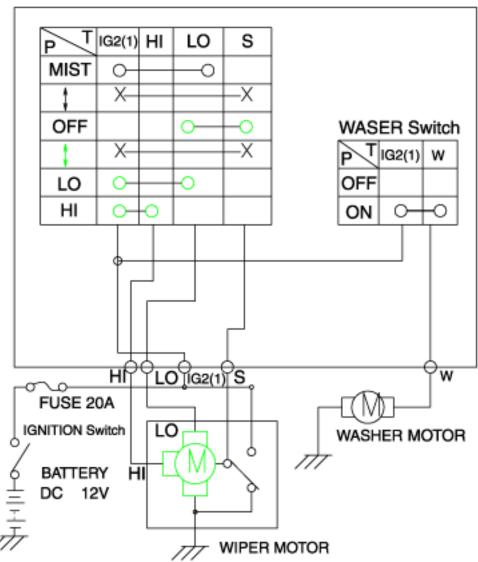
7	6	5	4	2	3	1	
14	13	12	11	10	9	8	
RHD (UP Type)							
7	6	5	4	3	2	1	
14	13	12	11	10	9	8	

RHD (DOWN Type)

NO	CIRCUIT	DESCRIPTION
1	EW	Wiper GND
2	HI	Wiper HI speed
3	IG2(1)	Wiper & washer & mist power
4	LO	Wiper LOW speed
5	S+	Wiper parking
6	WA	Front washer
7	-	-
8	-	-
9	-	-
10	-	-
11	RP	Rear parking
12	RWA	Rear washer
13	RS	Rear wiper
14	IG2(2)	Rear wiper & washer power



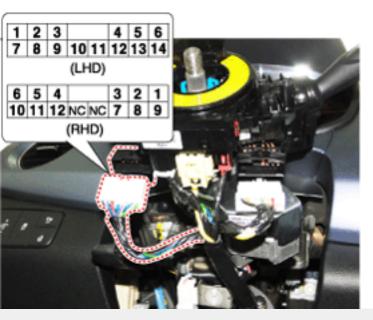




#### **INSPECTION**

### **Lighting Switch Inspection**

With the multifunction switch in each position, make sure that continuity exists between the terminals below. If continuity is not as specified, replace the multi-function switch.



#### **Lighting Switch**

Terminal Position	1	5	6	2
Off				
Tail lamp	0—	—		
Head lamp	0	<u> </u>	<b>○</b>	<u> </u>

#### **Dimmer And Passing Switch**

Terminal Position	6	3	4	2
HU		0		_
HL			0	—
Р	0—	_0_		—

HU: Head lamp high beam
HL: Head lamp low beam
P: Head lamp passing switch
HS: Head lamp switch(Short inside)

#### **Turn Signal Switch**

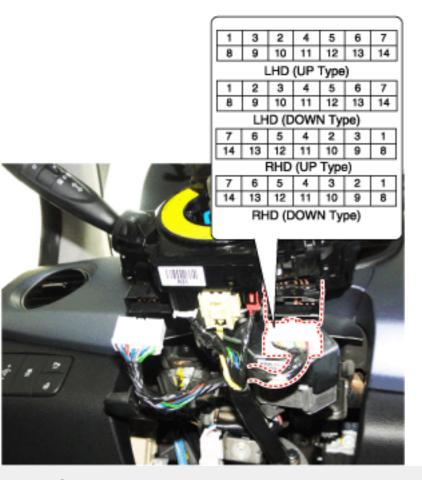
Hazard Switch	Terminal Turn Signal Switch	10	11	12
	L		0	$\overline{}$
OFF	N			
	R	0—		

#### Front & Rear Fog Lamp

Terminal Position	8	7	9
Off			
Front	0	<u> </u>	
Front + Rear	0	—o—	<u> </u>

## Wiper And Washer Switch Inspection

With the multifunction switch in each position, make sure that continuity exists between the terminals below. If continuity is not as specified, replace the multi-function switch.



#### **Wiper Switch**

Terminal Position	3	2	4	5	INT1	INT2	B1
MIST	0		0				
OFF			0	$\overline{}$	0		-0
INT			0	0	0	0	
LOW	9		0				
н	0	-0					

#### **Washer Switch**

Terminal Position	3	6
OFF		
ON	0	

#### **Rear Wiper Switch**

Terminal Position	13	11	14
OFF	0		
ON	0		

#### **Rear Washer Switch**

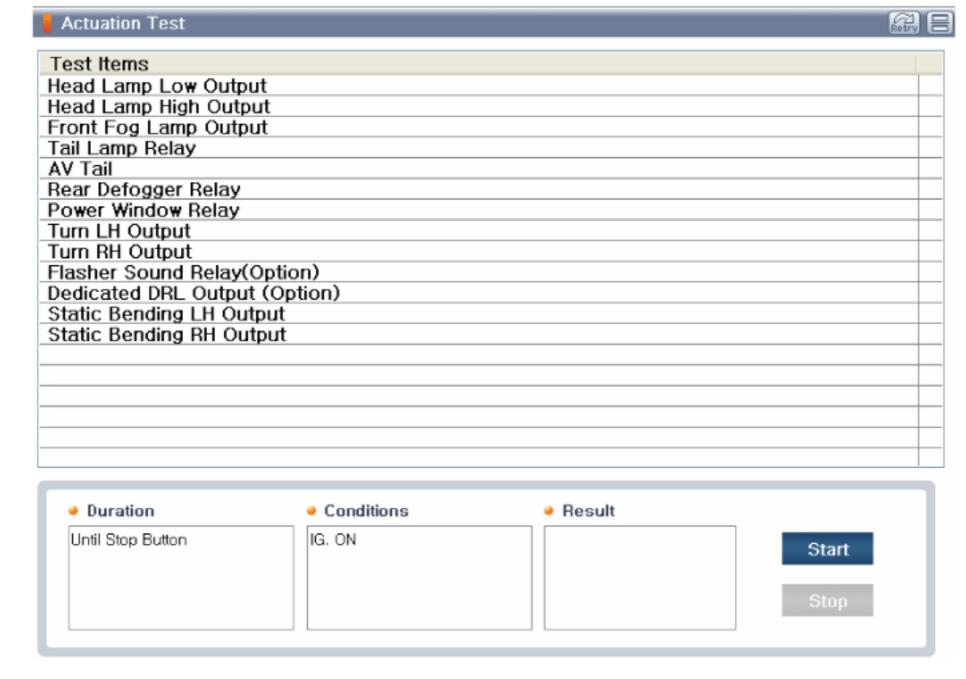
Terminal Position	13	14	12
OFF			
ON	0-	<u> </u>	<u> </u>

### **INSPECTION (WITH GDS)**

- 1. Check BCM input/output specification of multifunction switch using the GDS. If the specification is abnormal, replace the lamp or wiper switch.
- 2. If diagnosis is required on the multifunction switch, select model and "BCM".
- 3. To consult the present input/output value of BCM, "Current DATA". It provides information of BCM input/output conditions of power supply, turn signal/brake lamp, headlamp, door, locks, outside mirror, wiper, auto-light and transmitters etc.



4. To perform compulsory operation on BCM input factors, select "ACTUATION TEST".



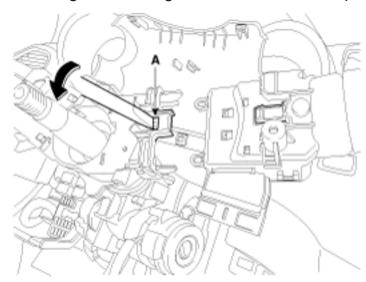
#### **REMOVAL**

- 1. Disconnect the negative (-) battery terminal.
- Remove the steering wheel. (Refer to Steering System - "Steering Wheel")
- 3. Remove the steering column shroud lower/upper panel. (Refer to Body "Steering Column Shroud Panel")
- Remove the clock sping.
   (Refe to Restraint "Driver Airbag (DAB) and Clock Spring")
- 5. Disconnect the lighting switch connector (A) and wiper & washer switch connector (B).

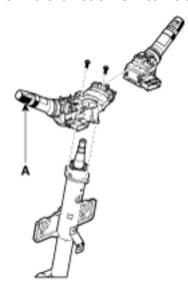


6. If it is necessary to remove. The wiper & washer switch (A) only, release the lock of wiper switch using tool without

removing the steering wheel and the clock spring.



7. Remove the multifunction switch assembly (A) after loosening 2 screws.



### **INSTALLATION**

- 1. Install the multifunction switch.
- 2. Install the clock spring.
- 3. Install the steering column upper and lower shrouds.
- 4. Install the steering wheel.

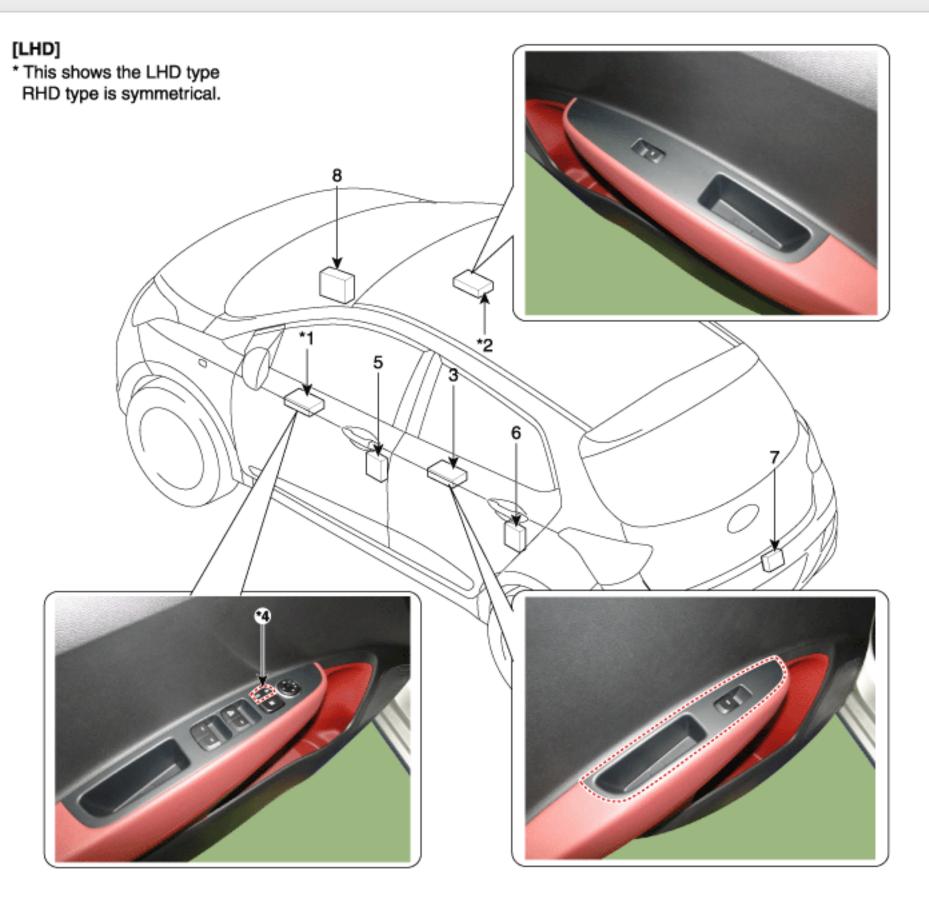
## NOTICE

Make sure the multifunction switch connectors are plugged in properly.

# **SPECIFICATIONS**

Items		Specifications	
Rated voltage		DC 12V	
Operating temperature range	е	-22 ~ +176°F (-30°C ~ +80°C)	
Rated load	Lighting switch	Head lamp : 21W (Lamp load)	
	Dimmer & passing switch	Head lamp low: 110W (Lamp load) Head lamp high: 120W (Lamp load) Tail lamp: 66W (Lamp load)	
	Turn signal switch	Turn signal lamp : 69W (Flasher unit)	
	Front & rear fog lamp switch	0.2A (Relay load)	
	Wiper & mist switch	Mist Low, High: 5A (Motor load) Intermittent: 7mA (Relay load) Lock Low, High: 25A (Motor load) Washer: 5.0A (Motor load)	
	Rear wiper & washer	Wiper : 3.5A (Motor load) Washer : 5A (Motor load)	

#### **COMPONENT LOCATION**

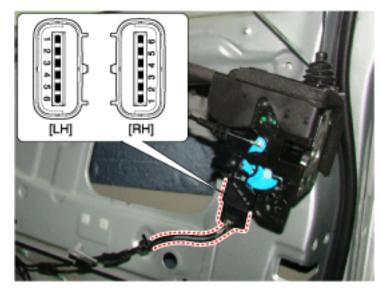


- 1. Driver power window main switch
- 2. Passenger power window switch
- 3. Rear power window switch
- 4. Door lock switch

- 5. Front door lock actuator
- 6. Rear door lock actuator
- 7. Tailgate latch
- 8. BCM (Body Control Module)

### **Door Lock Module Inspection**

- Remove the front door trim.
   (Refer to Body "Front Door Trim")
- Remove the front door module. (Refer to Body - "Front Door Module")
- 3. Disconnect the connector from the actuator.

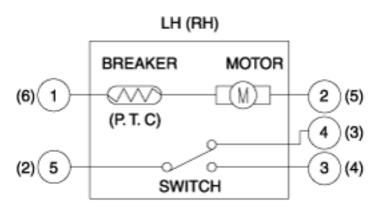


4. Check door module operation by connecting power and ground according to the table. And check the continuity between terminals.

#### NOTICE

To prevent damage to the actuator, apply battery voltage only momentarily.

#### [5pin Actuator type]



Termina	Operation	Lock	Unlock
	2	$\Theta$	$\oplus$
	1	0	$\Theta$
LH	3 and 4	-	-
	4 and 5	ON → OFF	OFF → ON
	5 and 3	OFF → ON	ON → OFF

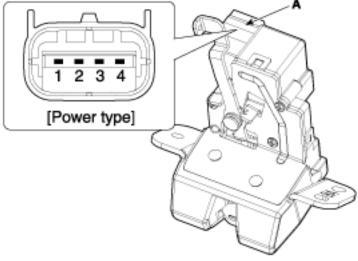
Termina	Operation	Lock	Unlock
	5	$\oplus$	$\ominus$
	6	$\Theta$	$\oplus$
RH	3 and 4	-	-
	2 and 3	ON → OFF	OFF → ON
	2 and 4	OFF → ON	ON → OFF

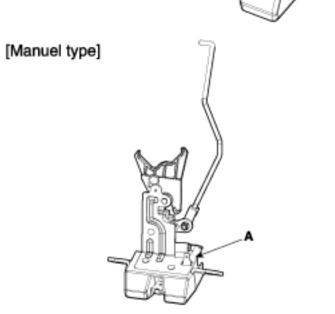
# Tailgate Latch Inspection

- Remove the tailgate trim.
   (Refer to Body "Tailgate Trim")
- 2. Remove the the tailgate latch (A) after loosening the bolts and nuts.



3. Disconnect the tailgate latch connector (A)





4. Check actuator operation by connecting power and ground according to the table. To prevent damage to the actuator,

apply battery voltage only momentarily.

### [Tailgate Latch - Power type]

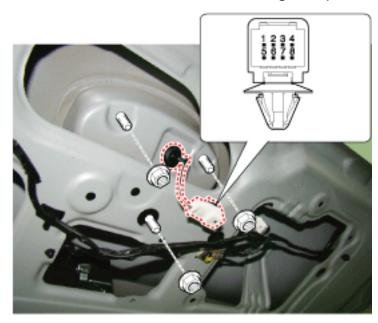
Operation Terminal	Lock ──→ Unlock
4	$\ominus$
3	$\oplus$
2	OFF → ON
1	

## [Tailgate Latch - Manual type]

Operation Terminal	Lock → Unlock	Unlock → Lock	
1	ON	OFF	
GND	ON	OFF	

## **Tailgate Open Switch**

- Remove the tailgate trim.
   (Refer to Body "Tailgate Trim")
- 2) Disconnect the connector from Tailgate open switch.

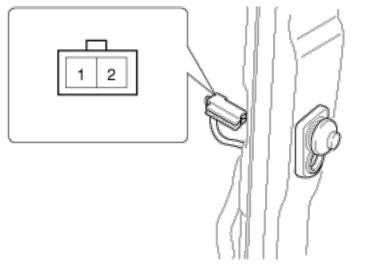


3) Check for continuity between the terminals in each switch position according to the table.

Terminal Position	1	2
OFF		
ON	0	

### **Door Switch Inspection**

Remove the door switch and check for continuity between the terminals.

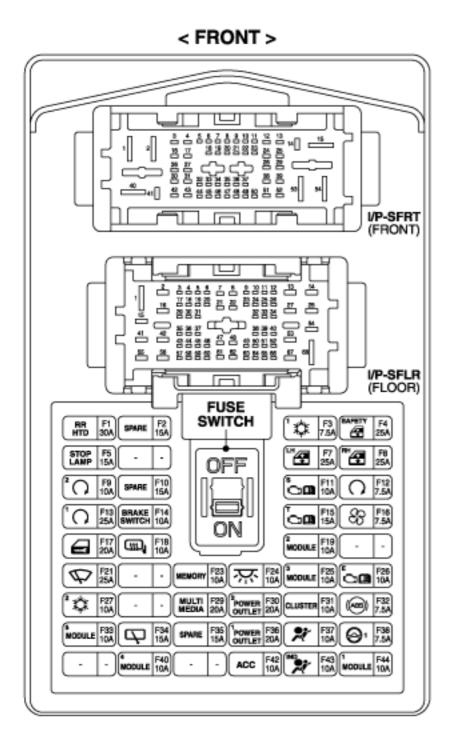


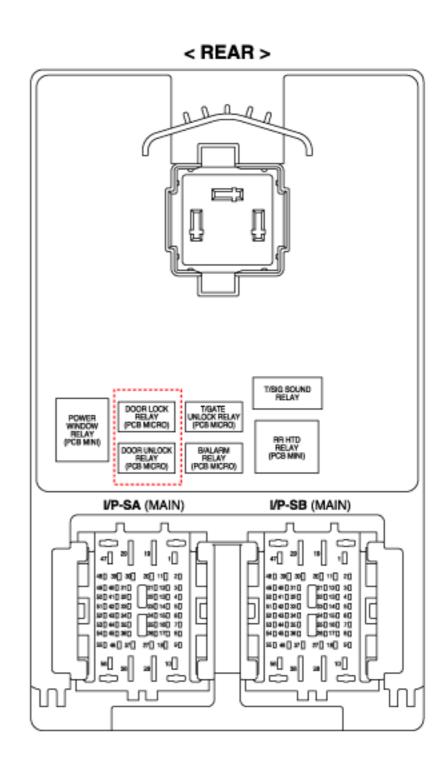
Terminal Position	4	2	Body (Ground)
Free(Door open)	$\sim$	$\overline{}$	<b>—</b> ○
Push(Door close)			

#### **COMPONENTS**

#### Fuse & Relay Information (1)

#### Smart Junction Block (With SJB/BCM)





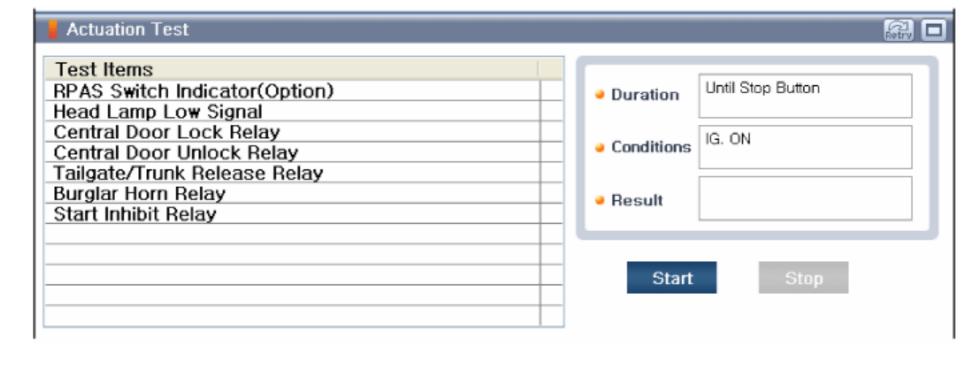
**W USE THE DESIGNATED FUSE & RELAY ONLY** 

#### Diagnosis With GDS

- 1. It will be able to diagnose defects of power door lock with GDS quickly. GDS can operates actuator forcefully, input/output value monitoring and self diagnosis.
- 2. Select model and "BCM".
- 3. Select "Current data", if you will check current data of power door lock system. It provides input/output status of BCM.



4. If you will check the power door lock operation forcefully, select "Actuation test" of BCM.

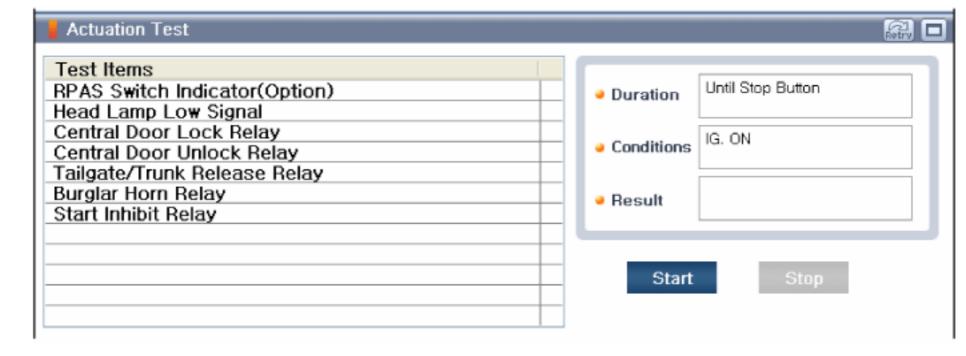


#### Diagnosis With GDS

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4. If you will check the power door lock operation forcefully, select "Actuation test" of BCM.



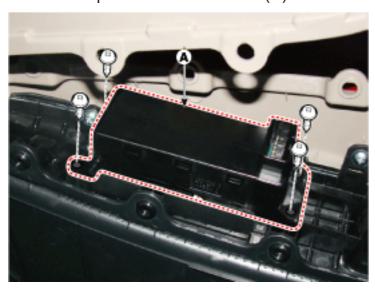
#### **REMOVAL**

#### **Driver Power Window Main Switch**

- 1. Disconnect the negative battery terminal.
- Remove the front door trim. (Refer to Body - "Front door trim")
- 3. Remove the door trim lower panel (A) from the front door trim after loosening the screws.



4. Remve the power window switch (A) after loosening the screws.

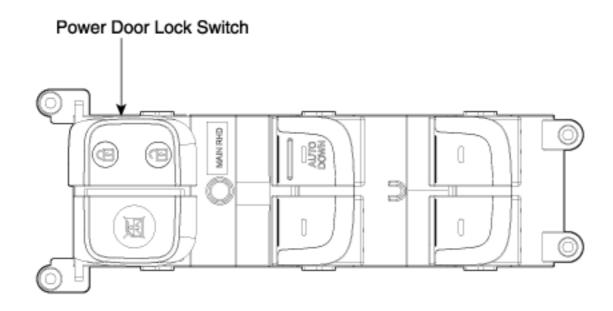


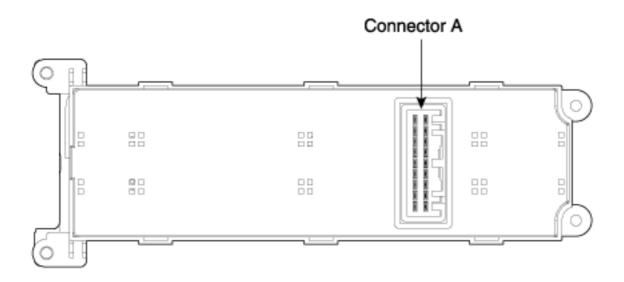
#### **INSTALLATION**

1.	Install the power window switch to the front door trim.
2.	Install the front door trim and door trim lower panel.

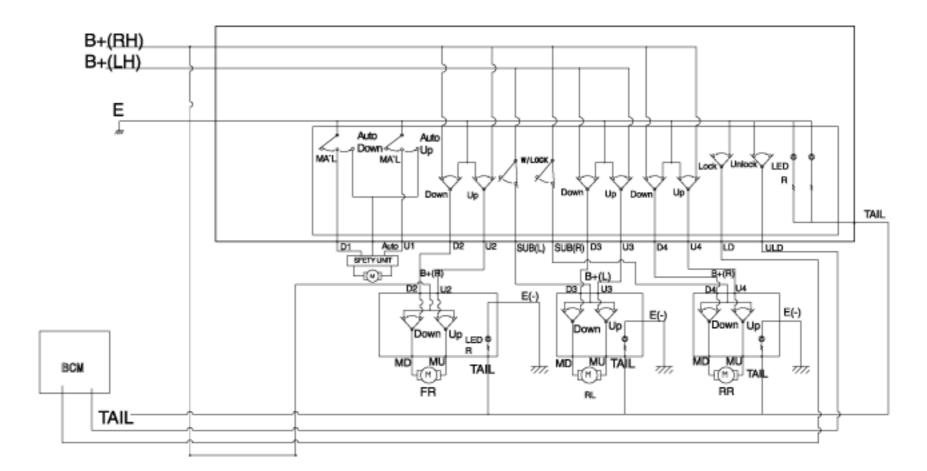
### **CIRCUIT DIAGRAM**

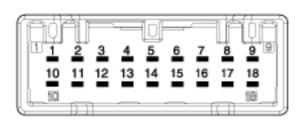
#### **DRIVER POWER WINDOW SWITCH**





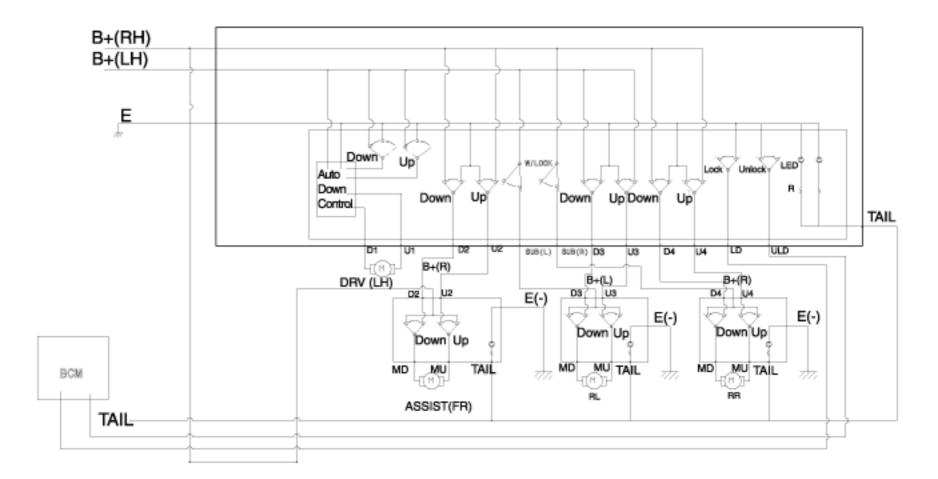
#### [Safety & 4DR & Door lock]

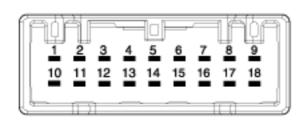




No.	Description	
140.	LHD	RHD
1	SUB (R)	Rear left down (RLD)
2	Lock door (LD)	Rear left up (RLU)
3	Unlock door (ULD)	Rear right down (RRD)
4	Tail lamp	Rear right up (RRU)
5	Rear left down (RLD)	-
6	Rear left up (RLU)	Tail lamp
7	-	Lock door (LD)
8	Rear right down (RRD)	Unlock door (ULD)
9	Rear right up (RRU)	SBU (R)
10	SUB (L)	Front left down (FLD)
11	Front left up (FLU)	Front left up (FLU)
12	Front left down (FLD)	E(-)
13	Auto	B+ (LH)
14	B+ (LH)	B+ (RH)
15	B+ (RH)	Auto
16	Front right down (FRD)	Front right down (FRD)
17	Front right up (FRU)	Front right up (FRU)
18	E(-)	SUB (L)

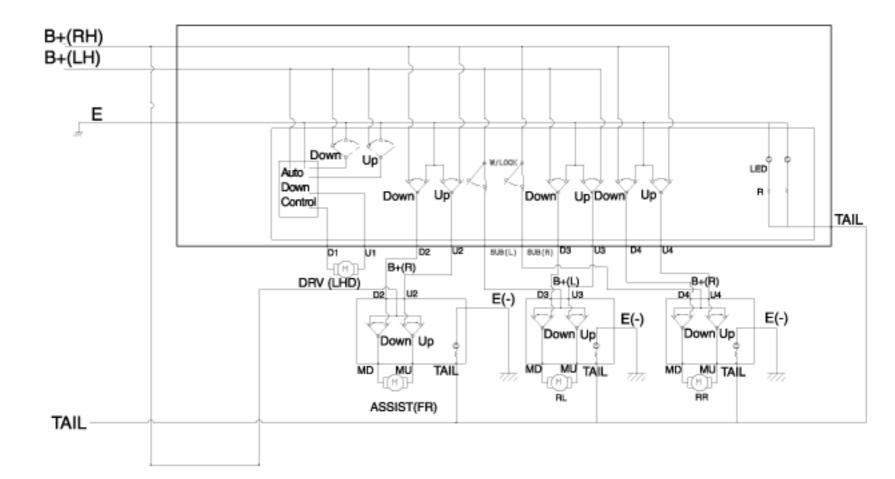
#### [Auto down & 4DR & Door lock]

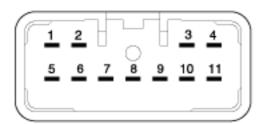




No. Description		ription
NO.	LHD	RHD
1	-	Rear left down (RLD)
2	Lock door (LD)	Rear left up (RLU)
3	Unlock door (ULD)	-
4	Tail lamp	Tail lamp
5	Rear left down (RLD)	Rear right down (RRD)
6	Rear left up (RLU)	Rear right up (RRU)
7	-	Unlock door (ULD)
8	Rear right down (RRD)	Lock door (LD)
9	Rear right up (RRU)	-
10	SUB (L)	Front left down (FLD)
11	Front left up (FLU)	Front left up (FLU)
12	Front left down (FLD)	E(-)
13	SUB (R)	B+ (LH)
14	B+ (LH)	B+ (RH)
15	B+ (RH)	SUB (L)
16	Front right down (FRD)	Front right down (FRD)
17	Front right up (FRU)	Front right up (FRU)
18	E(-)	SBU (R)

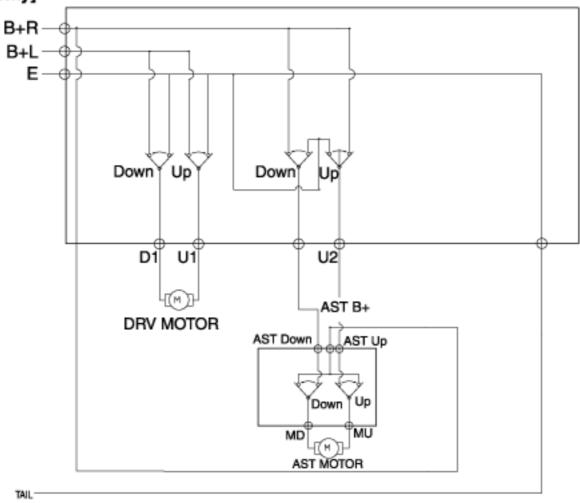
#### [Auto down & 4DR & Without door lock]

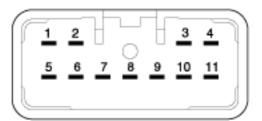




No.	Description
140.	RHD
1	-
2	Front left down (FLD)
3	-
4	Front right up (FRU)
5	E(-)
6	B+ (LH)
7	Front left up (FLU)
8	-
9	Front right down (FRD)
10	B+ (RH)
11	-

## [Manual & 2DR only]

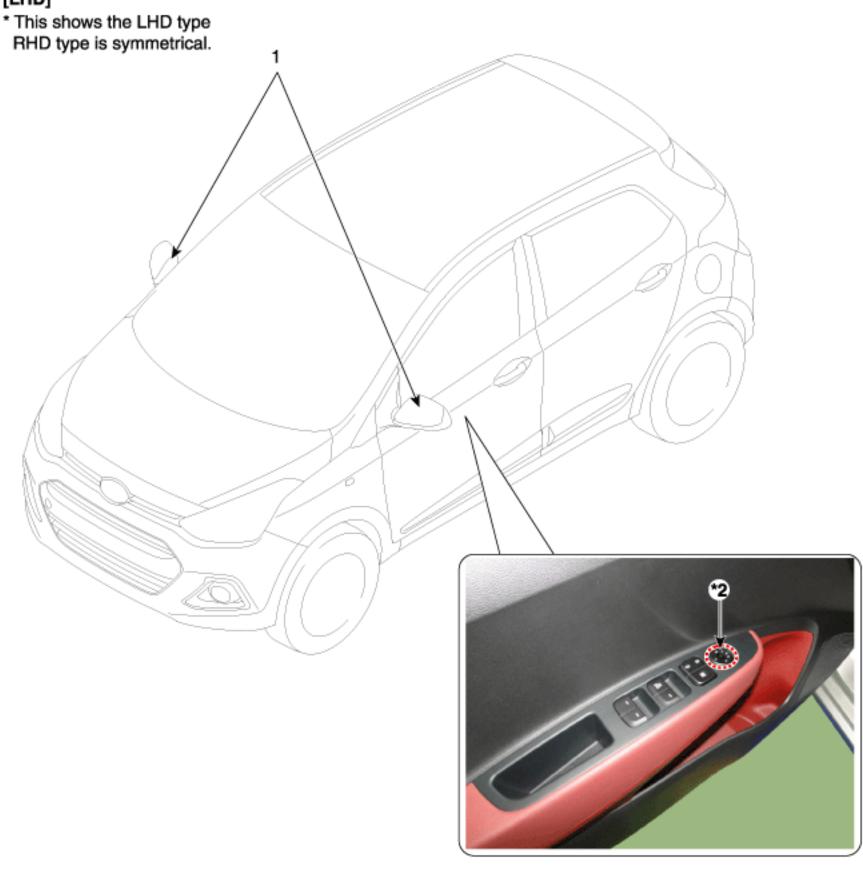




No.	Description
NO.	RHĎ
1	-
2	Front left down (FLD)
3	-
4	Front right up (FRU)
5	E(-)
6	B+ (LH)
7	Front left up (FLU)
8	-
9	Front right down (FRD)
10	B+ (RH)
11	-

### **COMPONENTS**

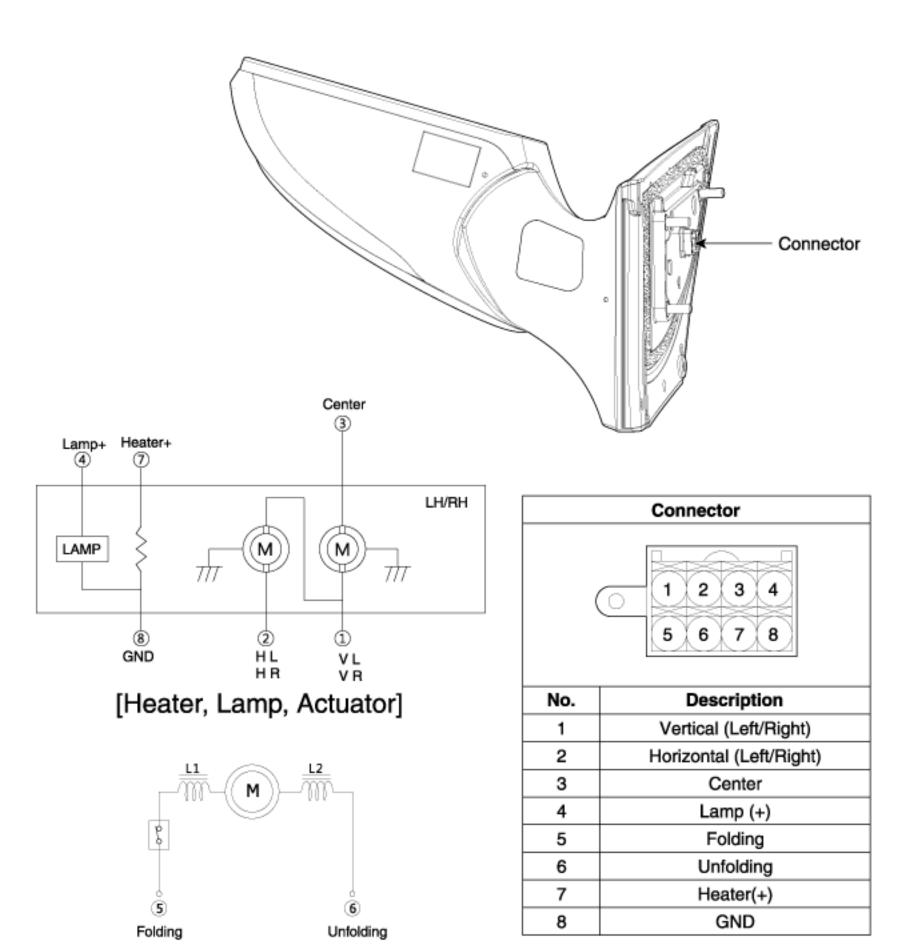




1. Power door mirror

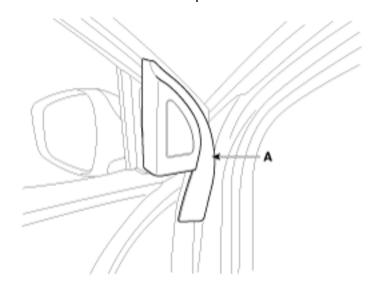
2. Power door mirror switch

#### **COMPONENTS**



[Folding]

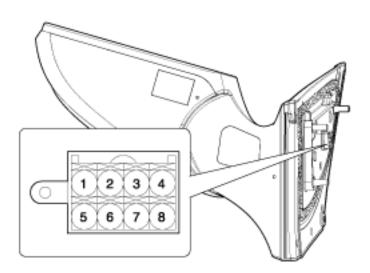
- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the front door quadrant inner cover.



3. Disconnect the connector (A) from the mirror.



4. Verify that the mirror operates properly as shown in the table.



$\overline{}$						
	Direction	1	2	3	B+	Ground
	Up	0	$\overline{}$	0	~	L-0
	Down	0		0	$\overline{}$	L-0
Left	Off	0			_	
	Right	0	0	0	_	L-0
	Left	0_	0	_	-0	
	Up	<u> </u>	$\overline{}$	0	$\overline{}$	
	Down	0_		0	$\overline{}$	L-0
Right	Off	0-	-0-		-	
	Right	0—	0-	0	0	L-0
	Left	_	Ŏ-	_	-0	

# Turn signal lamp

Terminal Position	4	8
Turn signal	<b>⊕</b>	$\Theta$

# Mirror heater

Terminal Position	7	8
Heater	<b>⊕</b>	$\Theta$

# **Folding Mirror**

Terminal Position	B(+)	GND(-)	5	6
Folding (R1)	$\overline{\circ}$	0	9	ð
Unfolding (R2)	<u></u>	0	-	$\overline{}$

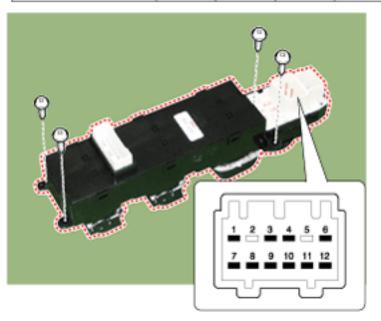
1. Check for continuity between the terminals in each switch position according to the table.

### [Power Mirror Switch]

Ope	ration	4	6	3	1	12	7	10
	Up	0	0			0-	19	9
	Down	$\frac{1}{2}$	$\downarrow$			6	19	9
Left	Off	0	<del>-</del> 0-			<del>-</del>		0
	Left	0	$\Diamond$			$\overline{}$	9	0
	Right	$\overline{\bigcirc}$	$\Diamond$			$\rightarrow$	9	9
	Up			9	0	Q	19	9
	Down			Ŷ	$\phi$	9	19	9
Right	Off			0	0	0		0
	Left			$\Diamond$	0	0	10	0
	Right		0		0	$\rightarrow$	19	0

# [Power Folding Mirror]

Terminal Position	10	11	9	8
Folding	0	$\overline{}$	$\overline{}$	_
Unfolding	<u> </u>	0	0	_



- 1. Disconnect the negative(-) battery terminal.
- Remove the driver door trim. (Refer to Body - "Front Door Trim")
- 3. Remove the door trim lower panel (A) from the front door trim after loosening the screws.



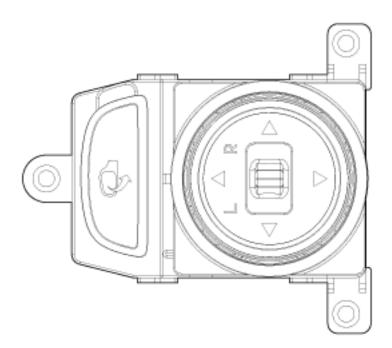
4. Remve the power window switch (A) after loosening the screws.

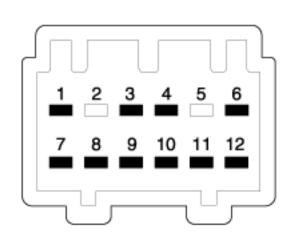


### **INSTALLATION**

- 1. Install the power mirror switch.
- 2. Install the front door trim after connecting the connector.
- 3. Connect the negative (-) battery terminal.

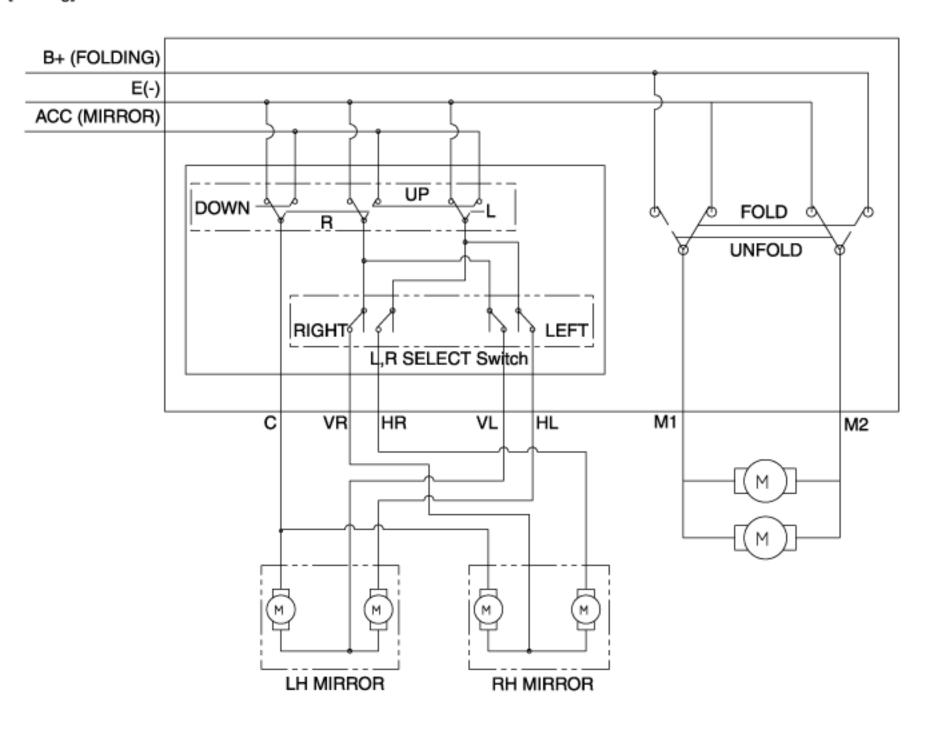
# **CIRCUIT DIAGRAM**

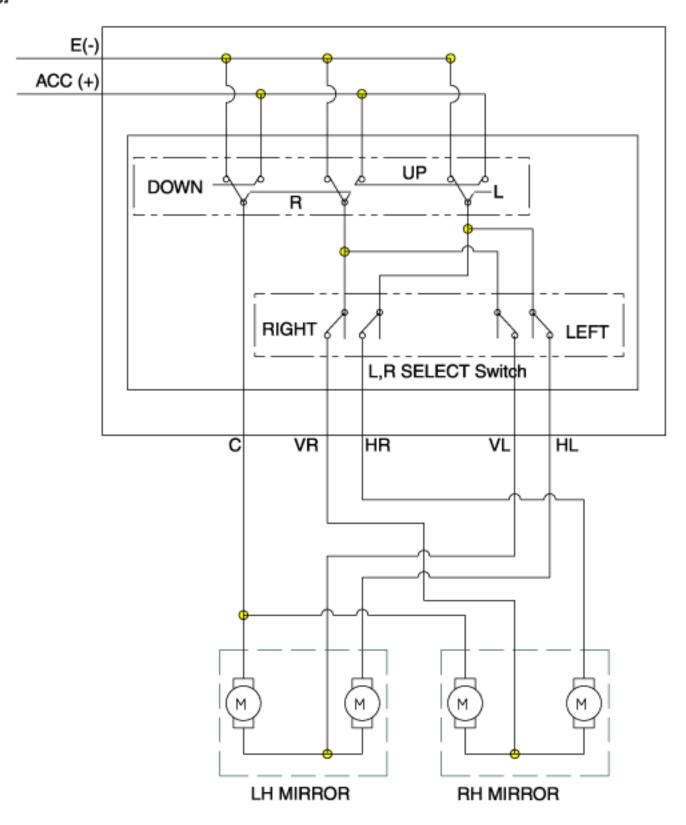




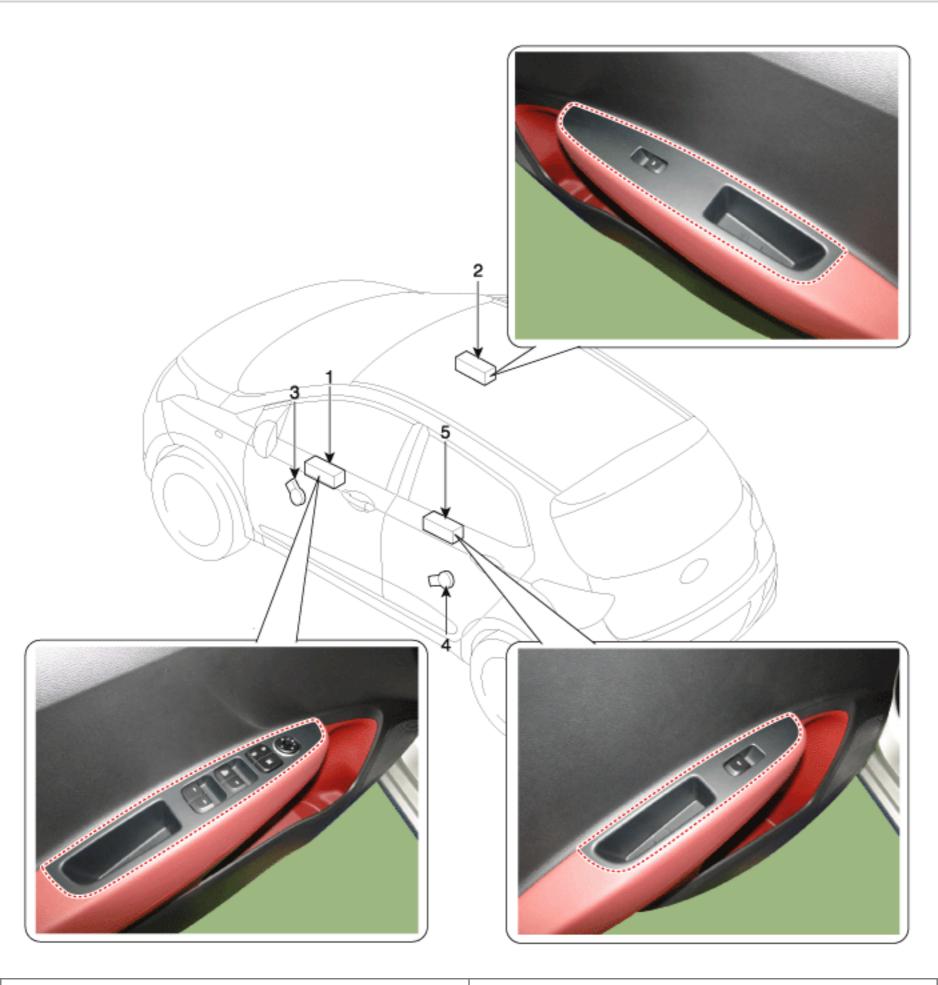
NO	Description (folding)	Description (without folding)
1	Horizontal RH	Horizontal RH
2	_	-
3	Vertical RH	Vertical RH
4	Vertical LH	Vertical LH
5	-	-
6	Horizontal LH	Horizontal LH
7	ACC	ACC
8	Folding switch	-
9	Unfolding switch	Unfolding switch
10	GND	GND
11	Battery (folding)	-
12	Mirror common	Mirror common

CLASS	DIR	VL	HL	VR	HR	С	ACC+	Е	B+	M1	M2
	UP	0-	L			P	-	_			
	DOWN	0	$\overline{}$			b	-	_			
LEFT HAND	OFF	0	$\vdash$			þ		_0			
	LEFT	0	0			þ	-	_			
	RIGHT	0	0			þ	-	_			
	UP			0	<u> </u>	0	-0	_			
	DOWN			0	$\vdash$	b	-	_			
RIGHT HAND	OFF			0	$\overline{}$	þ		—			
	LEFT			9	0	$^{\diamond}$	-0	_			
	RIGHT			0-	0	þ	-0	_			
FOLDING								0-	0	0	_
UNFOLDING								0-	6	0	_





## **COMPONENT LOCATION**



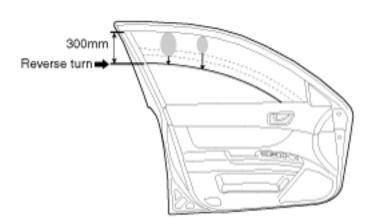
- 1. Driver power window main switch
- 2. Passenger power window switch
- 3. Front window motor

- 4. Rear window motor
- 5. Rear window switch

#### **FUNCTION OF SAFETY POWER WINDOW**

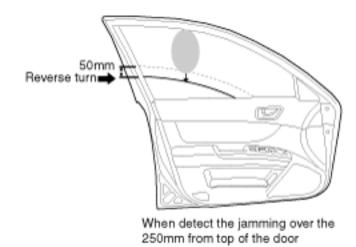
When driver door power window auto-up switch is operated, safety function is activated.

- 1. Safety function condition
  When detect the force of 100N (using the 10N/mm spring) during the window rising, window is reversed.
- 2. Length of window reversing (except holding the auto-up switch)
  - When detect the jamming during the 4mm ~ 250mm from top of the door.
    - → Window is reversed until 300mm from top of the door.

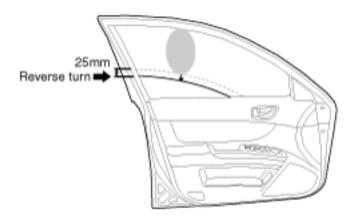


When detect the jamming during the 4mm~250mm from top of the door

- When detect the jamming over the 250mm from top of the door.
  - $\rightarrow$  Window is reversed until 50mm from jamming position.



- 3. Length of window reversing (holding the auto-up switch)
  - When detect the jamming during holding the auto-up switch.
    - → Window is reverse until 25mm from jamming position.
  - Auto-up function is not available during the 5 seconds from above condition.
    - → When holding the auto-up switch, window is operated as a manual-up function. (Safety function is not activated.)
  - When holding the auto-up switch after 5 seconds from above condition.
    - → Window is reverse until 25mm from jamming position.



When holding the auto-up switch

- Safety function is not available area
   Safety function is not available during the 4mm from top of the door.
  - Safety function is not available over the 300mm from top of the door.

# Initializing Method Of The Safety Power Window

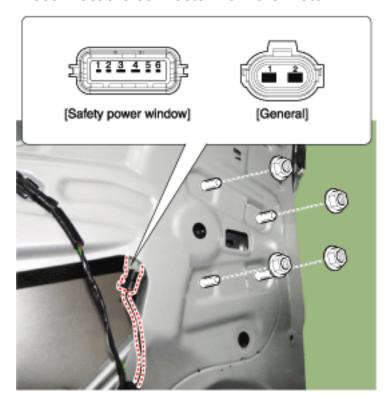
- 1. Initializing of Battery Connection
  - (1) Power window operation before initializing
    - Manual-Up/Down function is available
    - Auto-Up function is not available
       (When holding the auto-up/down switch, window is operated as a manual-up/down.)
  - (2) Initializing method
    - Close the window in window open position, and holding the switch in window full close position over the 2 second.

(If start the closing the window in window full close position, initializing could be failed.)

- (3) If initialize the safety power window in jamming status, could occur below conditions.
  - Safety function is not available
- 2. Initializing of fail safe mode
  - (1) If the window moved by compulsion and motor have a problem, power window switch could be entering the fail safe mode for user's safety.
  - (2) Power window operation in fail mode
    - Auto/Manual-Down function is available.
    - Auto-Up function is not available.
       (Only Manual-Up function is available)

#### Front Power Window Motor Inspection

- Remove the front door trim.
   (Refer to Body "Front Door Trim")
- 2. Disconnect the connector from the motor.



3. Connect the motor terminals No.2 and No.3 directly to battery voltage (12V) and check that the motor operates smoothly.

If the operation is abnormal, replace the motor.

### [Safety Power Window]

Posit	Terminal	1	4 (GND)	6
LH	Up	$\overline{\bigcirc}$	<del>-</del> 0	
LH	Down		0—	<u> </u>
RH	Up	$\overline{\bigcirc}$		
ПП	Down		<u> </u>	<u> </u>

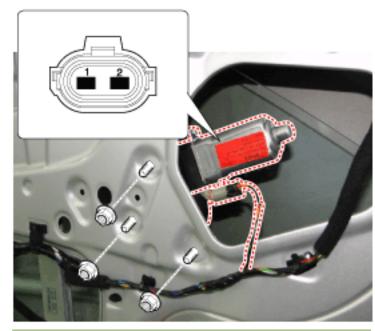
4. Connect the motor terminals directly to battery voltage (12V) and check that the motor operates smoothly. Next, reverse the polarity and check that the motor operates smoothly in the reverse direction. If the operation is abnormal, replace the motor.

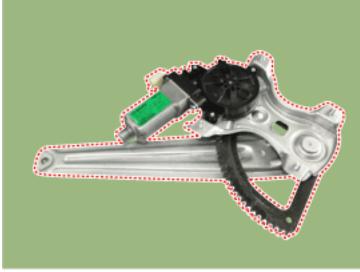
### [General Power Window]

Posi	tion	Terminal	1	2
	Up	Clockwise	$\ominus$	$\oplus$
LH	Down	Counter- clockwise	$\oplus$	$\Theta$
ры	Up	Counter- clockwise	Θ	<b>⊕</b>
RH	Down	Clockwise	$\oplus$	$\ominus$

### Rear Power Window Motor Inspection

- Remove the rear door trim.
   (Refer to Body "Rear Door Trim")
- 2. Disconnect the connector from the motor.





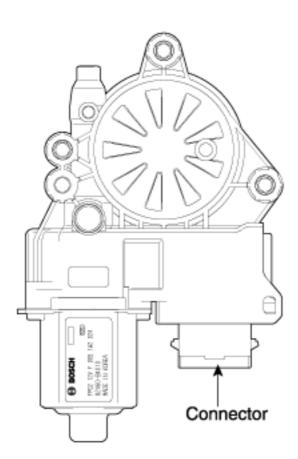
3. Connect the motor terminals directly to battery voltage (12V) and check that the motor operates smoothly. Next, reverse the polarity and check that the motor operates smoothly in the reverse direction. If the operation is abnormal, replace the motor.

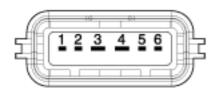
# [General Power Window]

Terminal Position			1	2
	Up	Counter- clockwise	$\ominus$	$\oplus$
LH	Down	Clockwise	$\oplus$	$\ominus$
RH	Up	Clockwise	$\ominus$	$\oplus$
пп	Down	Counter- clockwise	$\oplus$	Θ

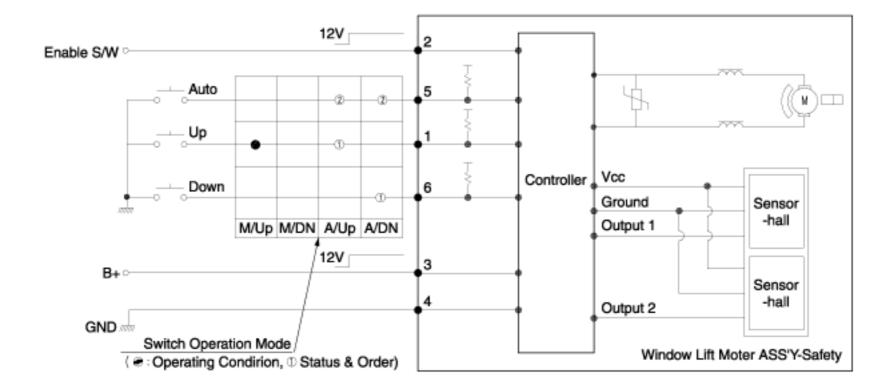
#### **CIRCUIT DIAGRAM**

#### [Safety window]

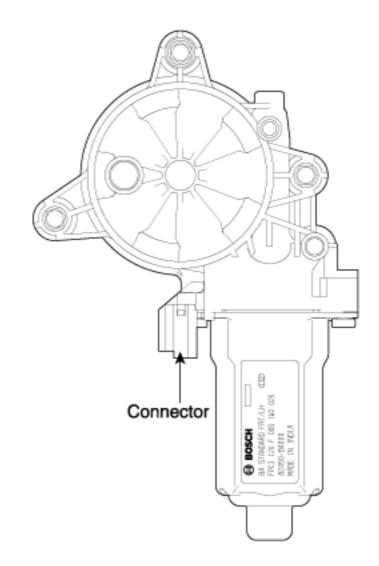


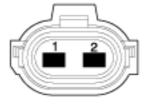


No.	Description	No.	Description
1	Up	4	Ground
2	Enable	5	Auto
3	Battery(+)	6	Down

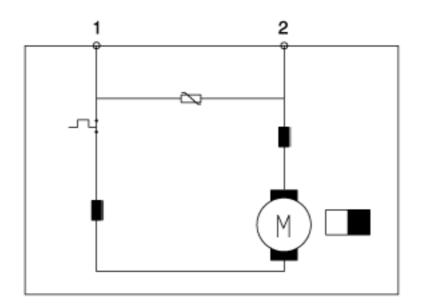


## [General Window]





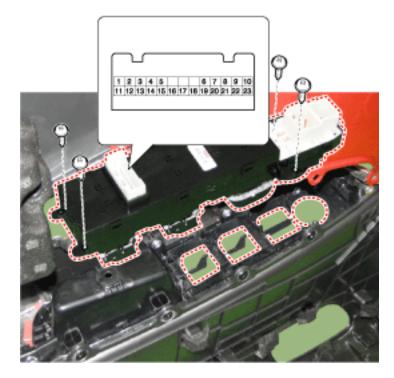
No.	Description
1	Θ
2	<b>⊕</b>



1. The power window relay is plugged in the I/P junction box. Refer to the "I/P junction box relay" to check the power window relay.

# Power Window Main Switch Inspection

- 1. Disconnect the negative (-) battery terminal.
- Remove the front door trim. (Refer to Body - "Front Door Trim")
- 3. Disconnect the connector from the switch.



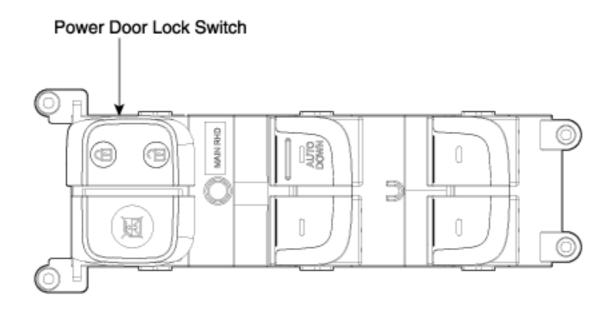
4. Check for continuity between the terminals in each switch position according to the "Circuit Diagram" of power window switch

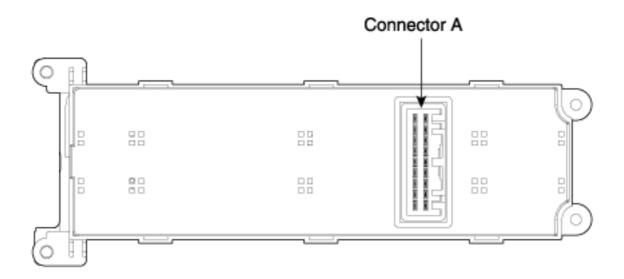
# NOTICE

If the continuity condition is not normal, replace the switch.

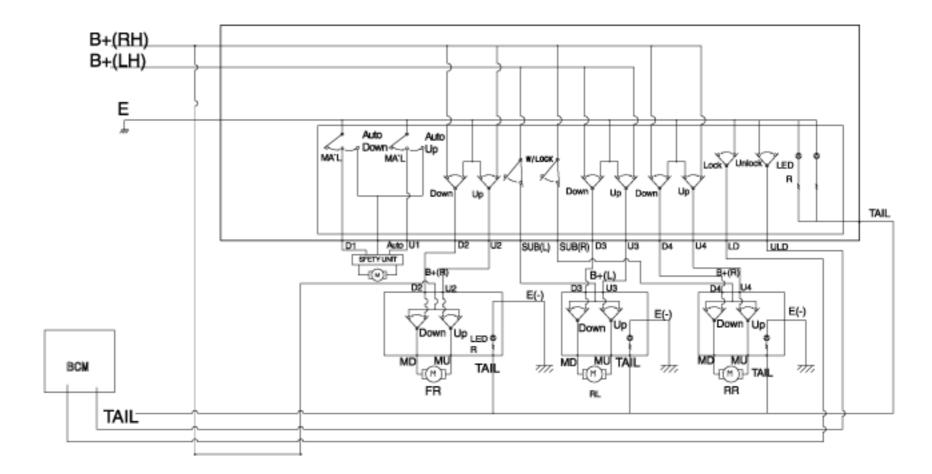
# **CIRCUIT DIAGRAM**

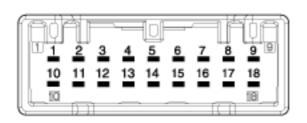
### **DRIVER POWER WINDOW SWITCH**





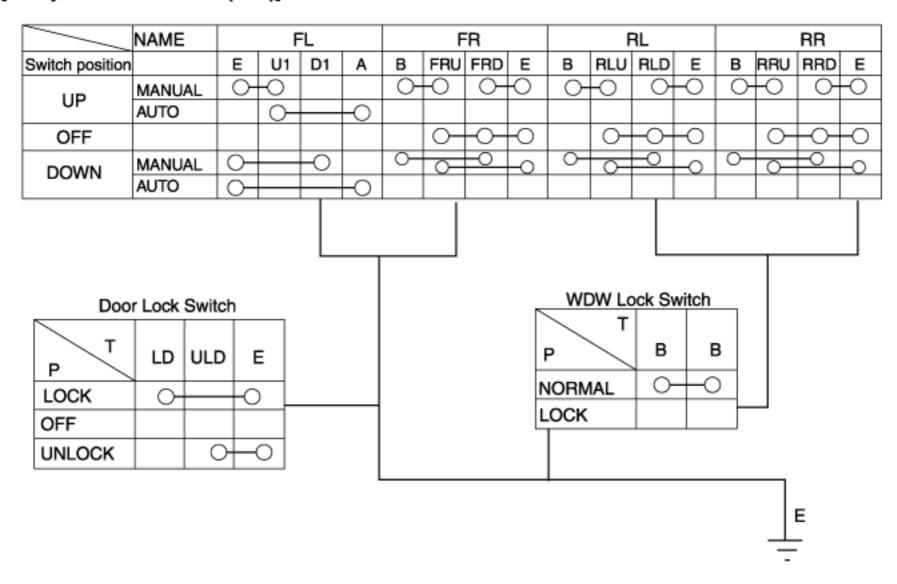
### [Safety & 4DR & Door lock]



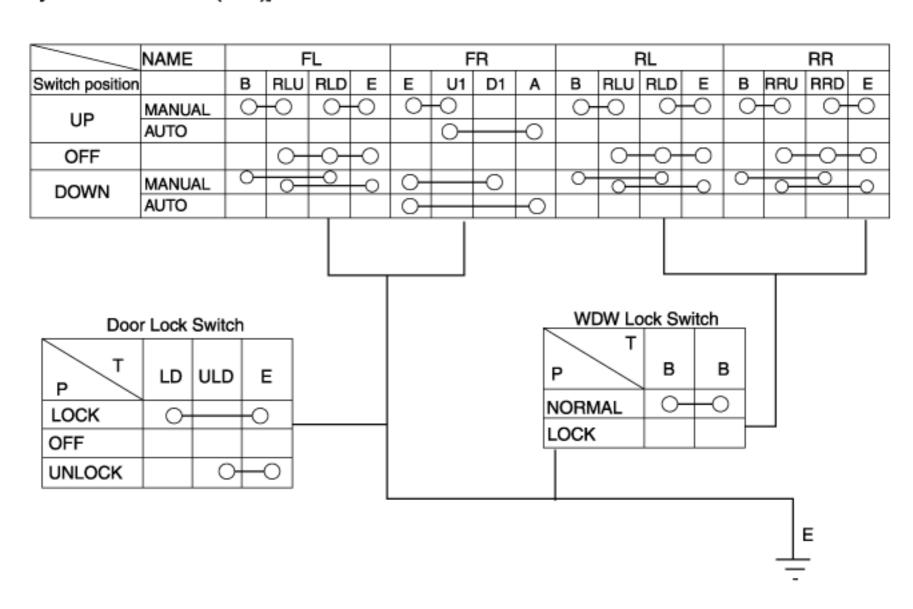


No.	Desc	ription
140.	LHD	RHD
1	SUB (R)	Rear left down (RLD)
2	Lock door (LD)	Rear left up (RLU)
3	Unlock door (ULD)	Rear right down (RRD)
4	Tail lamp	Rear right up (RRU)
5	Rear left down (RLD)	-
6	Rear left up (RLU)	Tail lamp
7	-	Lock door (LD)
8	Rear right down (RRD)	Unlock door (ULD)
9	Rear right up (RRU)	SBU (R)
10	SUB (L)	Front left down (FLD)
11	Front left up (FLU)	Front left up (FLU)
12	Front left down (FLD)	E(-)
13	Auto	B+ (LH)
14	B+ (LH)	B+ (RH)
15	B+ (RH)	Auto
16	Front right down (FRD)	Front right down (FRD)
17	Front right up (FRU)	Front right up (FRU)
18	E(-)	SUB (L)

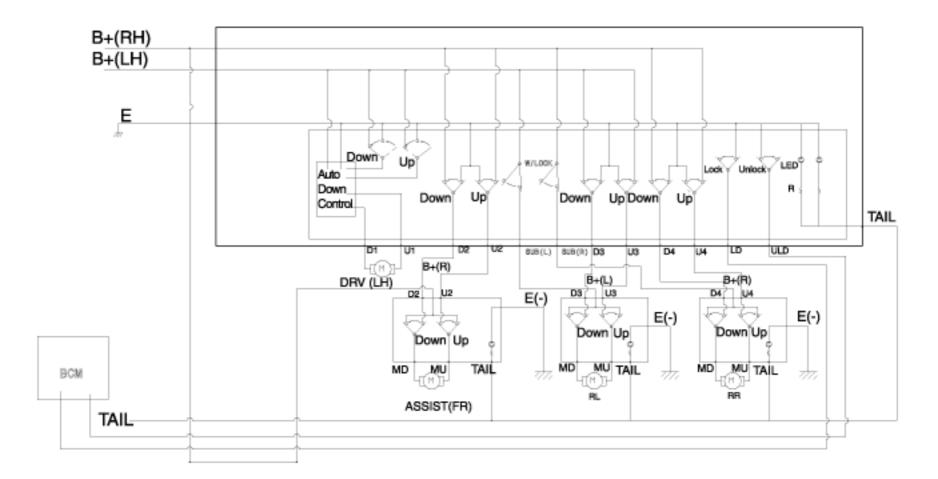
### [Safety & 4DR & Door lock (LHD)]

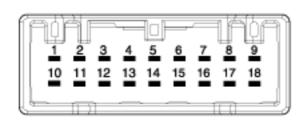


### [Safety & 4DR & Door lock (RHD)]



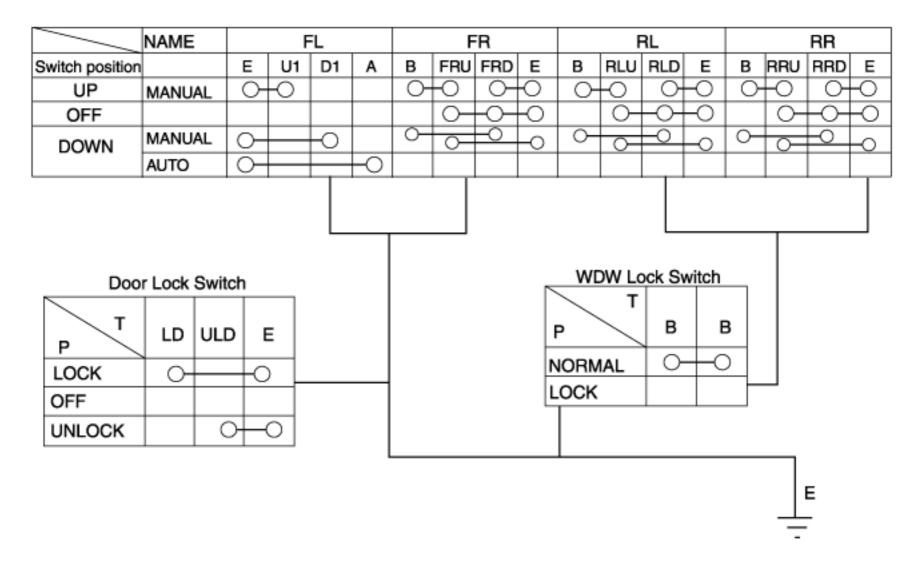
## [Auto down & 4DR & Door lock]



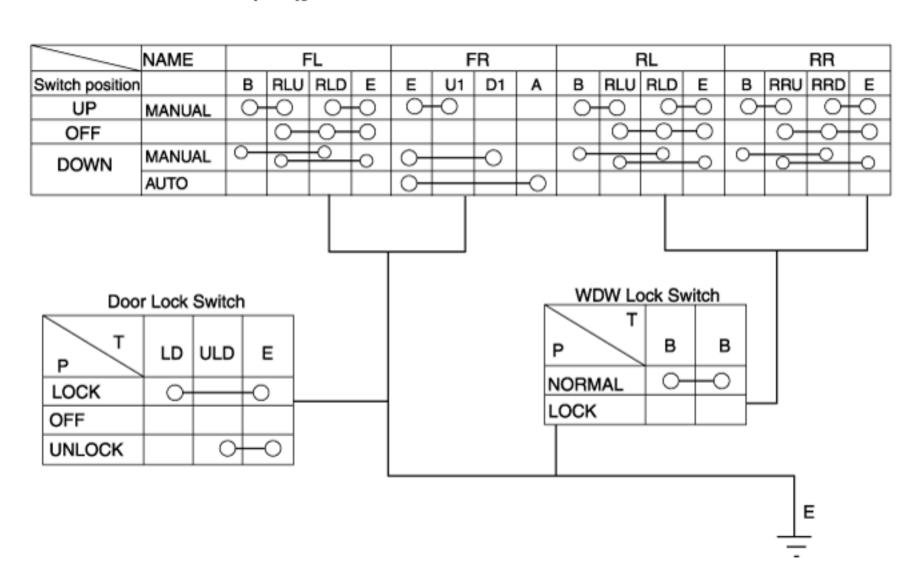


No.	Desc	ription
140.	LHD	RHD
1	-	Rear left down (RLD)
2	Lock door (LD)	Rear left up (RLU)
3	Unlock door (ULD)	-
4	Tail lamp	Tail lamp
5	Rear left down (RLD)	Rear right down (RRD)
6	Rear left up (RLU)	Rear right up (RRU)
7	•	Unlock door (ULD)
8	Rear right down (RRD)	Lock door (LD)
9	Rear right up (RRU)	•
10	SUB (L)	Front left down (FLD)
11	Front left up (FLU)	Front left up (FLU)
12	Front left down (FLD)	E(-)
13	SUB (R)	B+ (LH)
14	B+ (LH)	B+ (RH)
15	B+ (RH)	SUB (L)
16	Front right down (FRD)	Front right down (FRD)
17	Front right up (FRU)	Front right up (FRU)
18	E(-)	SBU (R)

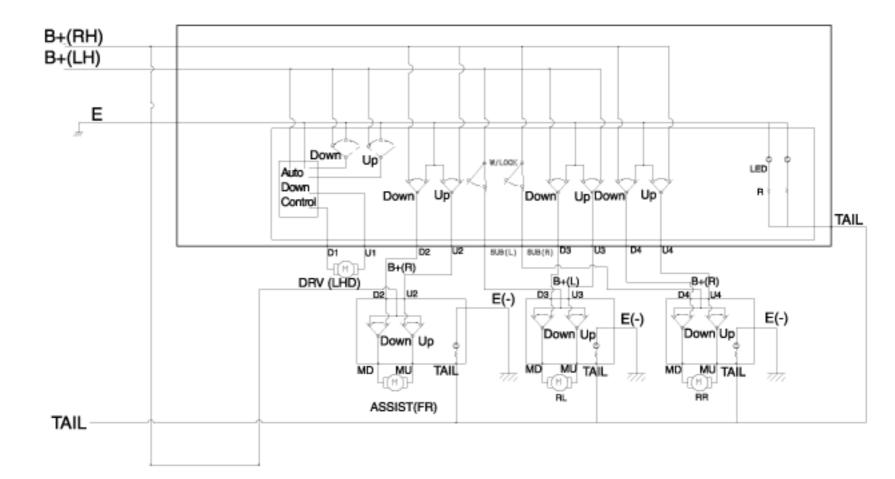
### [Auto down & 4DR & Door lock (LHD)]

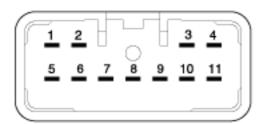


#### [Auto down & 4DR & Door lock (RHD)]



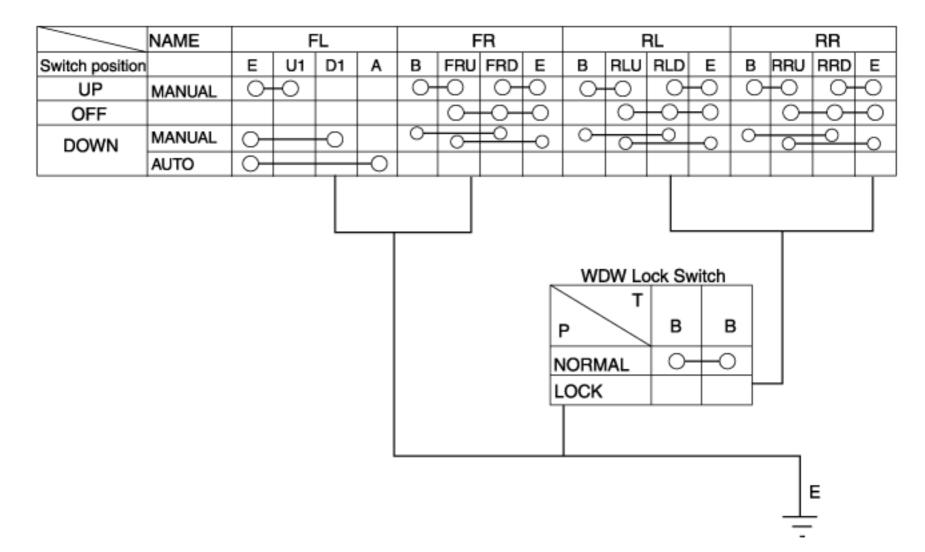
### [Auto down & 4DR & Without door lock]



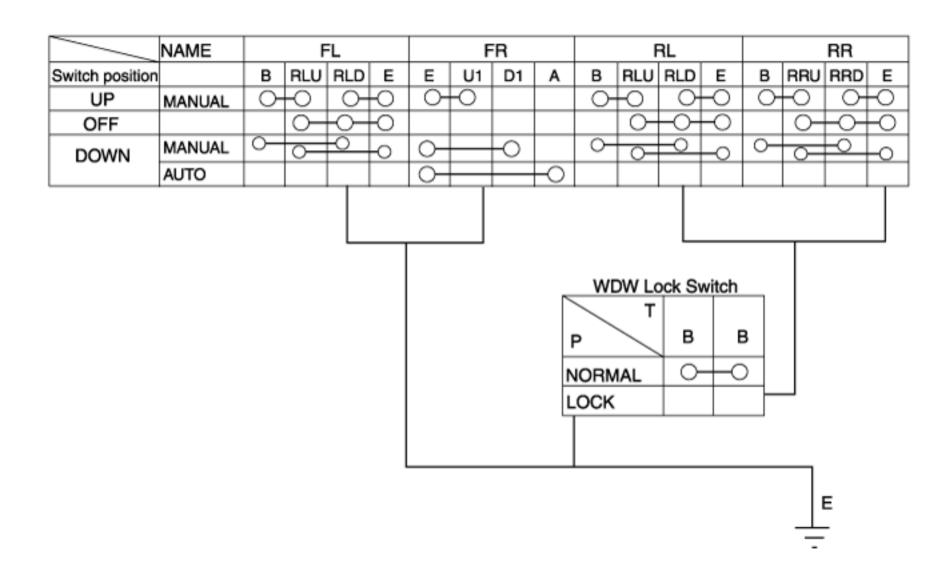


No.	Description
140.	RHD
1	-
2	Front left down (FLD)
3	-
4	Front right up (FRU)
5	E(-)
6	B+ (LH)
7	Front left up (FLU)
8	-
9	Front right down (FRD)
10	B+ (RH)
11	-

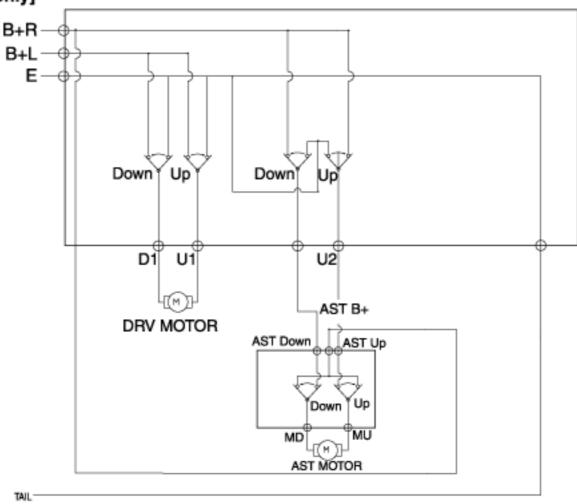
### [Auto down & 4DR & Without door lock (LHD)]

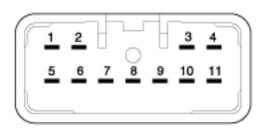


### [Auto down & 4DR & Without door lock (RHD)]



# [Manual & 2DR only]

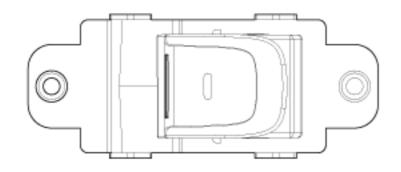


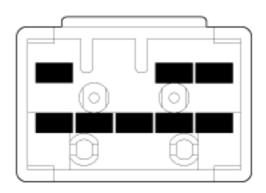


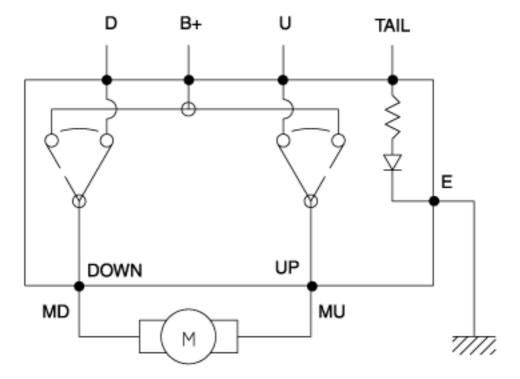
No.	Description
NO.	RHD
1	-
2	Front left down (FLD)
3	-
4	Front right up (FRU)
5	E(-)
6	B+ (LH)
7	Front left up (FLU)
8	-
9	Front right down (FRD)
10	B+ (RH)
11	-

# [Manual & 2DR only]

	NAME		F	-L			F	R	
Switch position		В	RLU	RLD	Е	Е	U1	D1	Α
UP	MANUAL	Q	9	9	9	Q	9	Q	9
OFF			9	þ	9		9	$\phi$	9
DOWN	MANUAL	$\Diamond$	0	9	9	P	Ь	9	P
	AUTO								





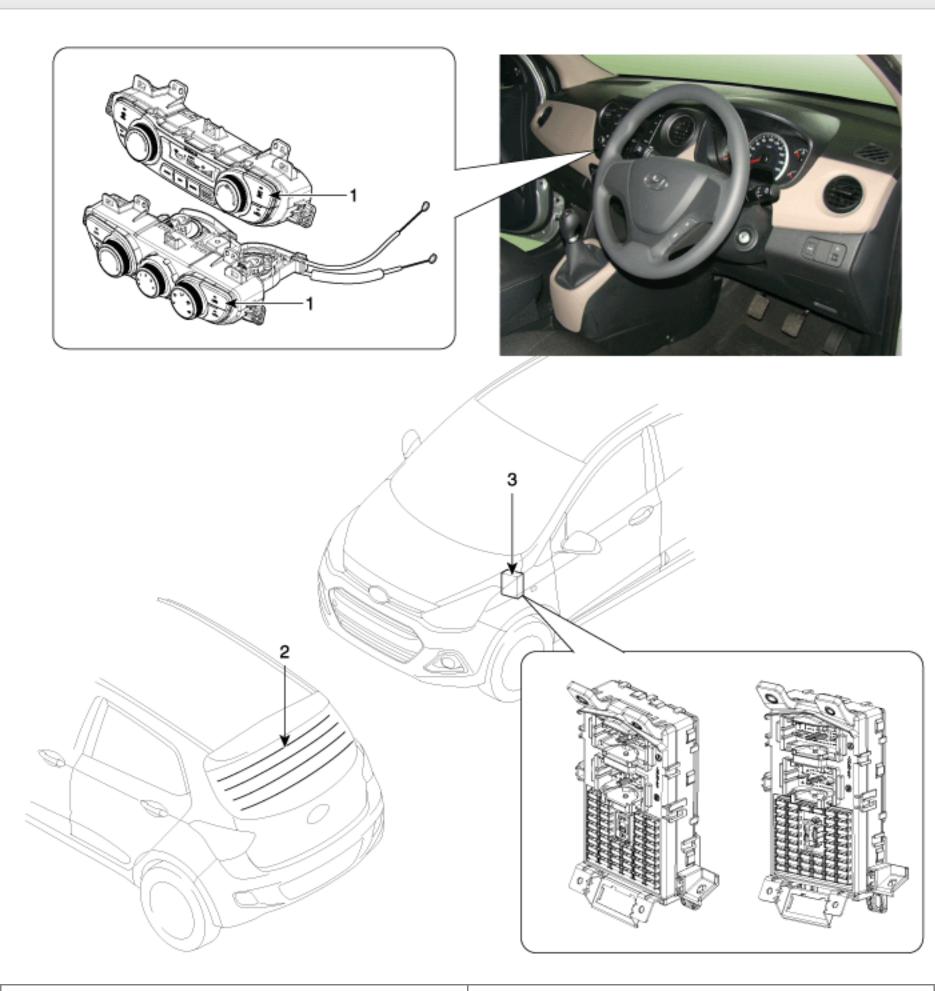


1	$\geq$	<	2	3
4	5	6	7	8

Switch Terminal	Powe	r wind	low s	witch
Position	5	8	6	7
Up		9		J
Off				
Down			9	9
Auto up	0	$\overline{}$		9
Auto down	0		$\downarrow$	9

No.	Description
1	Up
2	-
3	Down
4	Up from Driver
5	Tail lamp (option)
6	BL+ (BR+)
7	GND
8	Down from Driver

# **COMPONENT LOCATION**

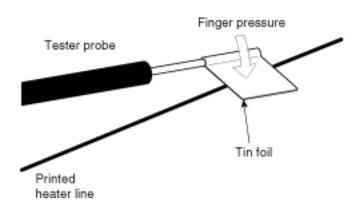


- 1. Rear glass defogger switch (A/C controller)
- 2. Rear glass defogger

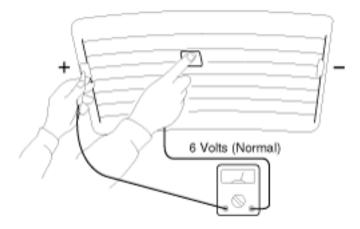
3. Rear glass defogger relay(PCB Mini type)

# **▲** CAUTION

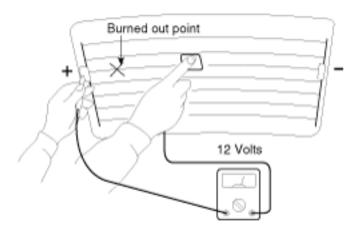
Wrap tin foil around the end of the voltmeter test lead to prevent damaging the heater line. Apply finger pressure on the tin foil, moving the tin foil along the grid line to check for open circuits.



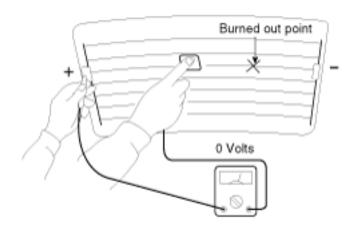
1. Turn on the defogger switch and use a voltmeter to measure the voltage of each heater line at the glass center point. If a voltage of approximately 6V is indicated by the voltmeter, the heater line of the rear window is considered satisfactory.



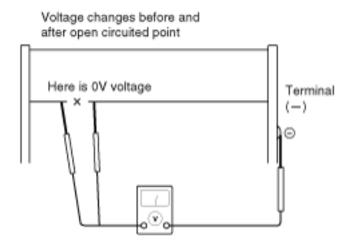
2. If a heater line is burned out between the center point and (+) terminal, the voltmeter will indicate 12V.



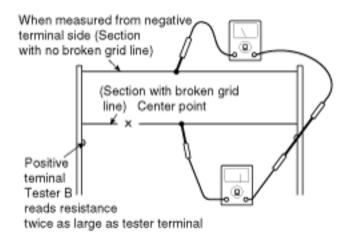
3. If a heater line is burned out between the center point and (-) terminal, the voltmeter will indicate 0V.



4. To check for open circuits, slowly move the test lead in the direction that the open circuit seems to exist. Try to find a point where a voltage is generated or changes to 0V. The point where the voltage has changed is the open-circuit point.



5. Use an ohmmeter to measure the resistance of each heater line between a terminal and the center of a grid line, and between the same terminal and the center of one adjacent heater line. The section with a broken heater line will have a resistance twice as that in other sections. In the affected section, move the test lead to a position where the resistance sharply changes.



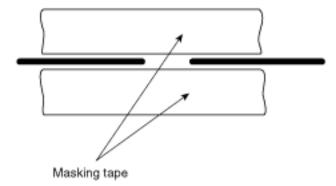
## Repair Of Broken Heater Line

Prepare the following items:

- 1. Conductive paint.
- 2. Paint thinner.
- 3. Masking tape.
- 4. Silicone remover.
- 5. Using a thin brush:

Wipe the glass adjacent to the broken heater line, clean with silicone remover and attach the masking tape as

shown. Shake the conductive paint container well, and apply three coats with a brush at intervals of about 15 minutes apart. Remove the tape and allow sufficient time for drying before applying power. For a better finish, scrape away excess deposits with a knife after the paint has completely dried. (Allow 24 hours).



1. The rear glass defogger relay is plugged in the I/P junction box. Refer to the "I/P junction box relay" to check the power window relay.

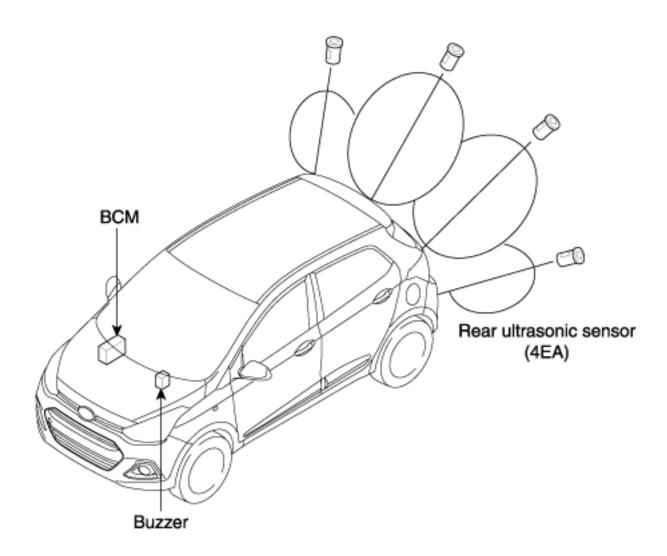
### **REMOVAL**

- 1. Disconnect the negative (-) battery terminal.
- Remove the heater and A/C controller after loosening screws.
   (Refer to Heating, Ventilation, Air Conditioning "Heater & A/C Control Unit (MANUAL)")

### **INSTALLATION**

- 1. Install the heater and A/C controller to the center fascia panel.
- 2. Connect the negative (-) battery terminal.

# **COMPONENT LOCATION**

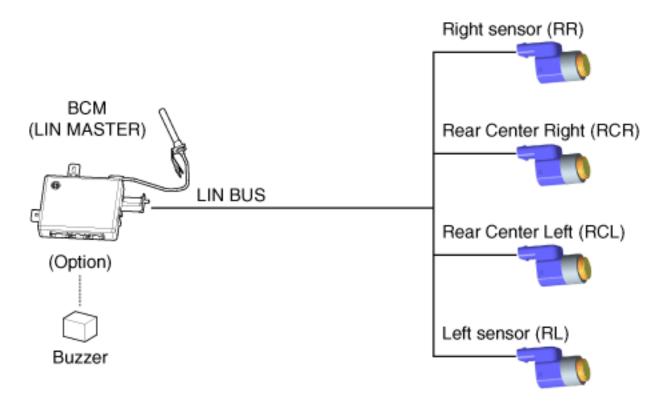


\* Parking assist control unit function is built in BCM (Body Control Module)

### **SYSTEM OVERVIEW**

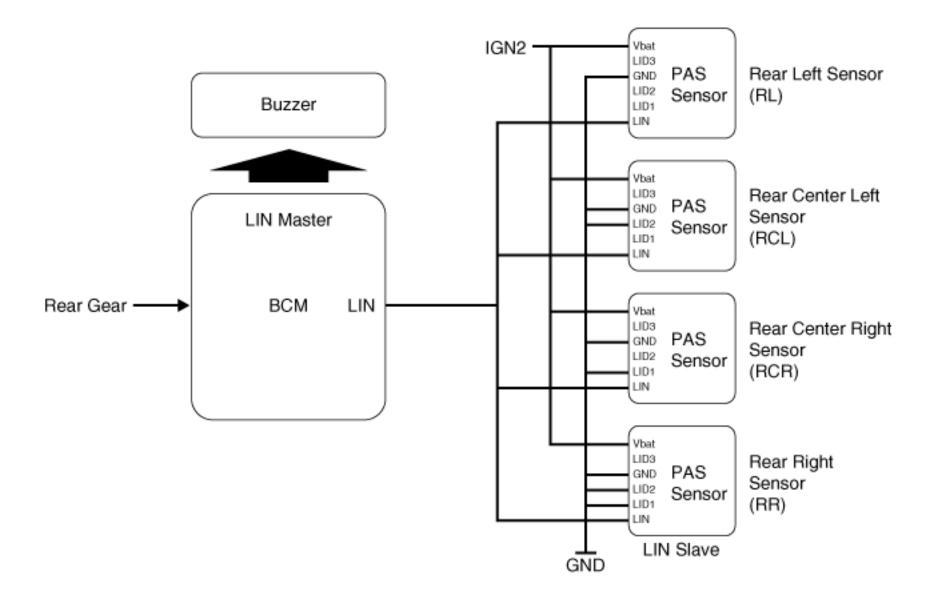
RPAS(Rear Parking Assist System) is an electronic driving aid device warning driver to be cautious when they park or speed low after detecting an object on side and behind of vehicle by using the feature of ultrasonic waves.

RPAS consists of four RPS sensors which are detecting the obstacles and transmit the result separated into three warning levels, the first, second and third to BCM by Lin communication. BCM decides the alarm level by the transmitted communication message from the slave sensors, then operate the buzzer or transmits the data for display.



Digital passenger assist sensor

System Block Diagram



### System Operation Specification.

- 1. INIT mode
  - (1) System initializing time is 500ms after IGN1+ R Gear.
  - (2) RPAS recognizes LID and sets the sensor ID up during initialization.
  - (3) RPAS activates each sensor and then executes the diagnosis after finishing initialization of BCM
  - (4) R-PAS Starting buzzer" is normally worked, when sensor does not send an error message and after finishing error diagnosis.
  - (5) If any failure is received from the any sensors, R-PAS Starting Buzzer" does not work but the failure alarm is operated for a moment.
    If you have display option, warning sign is also shown on it.
  - (6) Buzzer for sensor failure is operated once, but display is shown continuously until it is repaired completely.

#### 2. NORMAL Mode

- (1) LIN communication starts and keeps the routine after IGN1 ON+R gear
- (2) BCM send a message once to each sensor for operating request to check the initial status of the system and four sensors response at a time. At this time, if there is no problem, the alarm starts after 500ms of R gear shifting at 300ms intervals.
- (3) After initialization, normal mode starts 100ms later after finishing alarm output.
- (4) Alarm for obstacles is divided into 3 levels.

  The first and second are intermittent sound, and the third alarms continuously (Front sensor have second and third alarms.)
- (5) The efficient vehicle speed of RPAS operation is under 10Km/h.

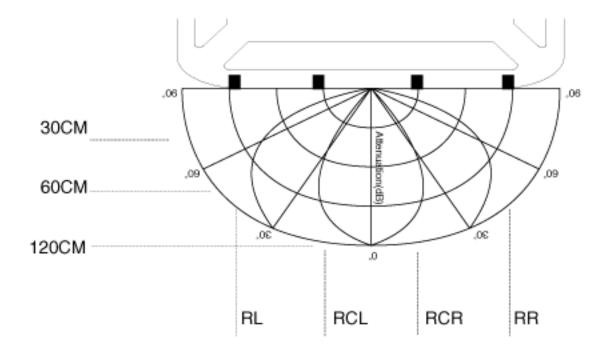
(6) Refer to 'Digital PAS Project LIN communication' for the more detailed communication specification.

## Sensing Area

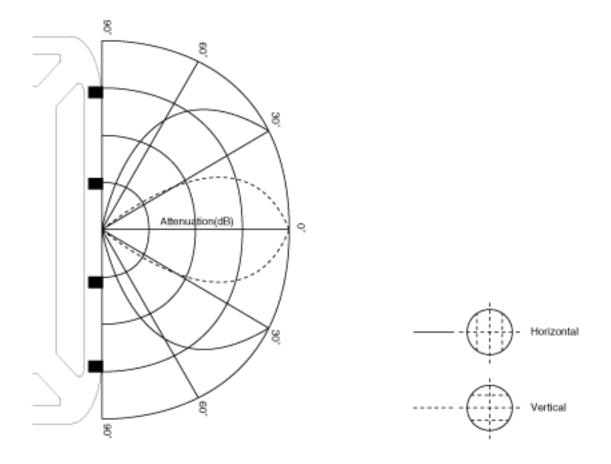
- 1. Measurement condition PVC pole (diameter 75mm, length 3m), normal temperature
- 2. Distance range detected objects (Measured directly in front of sensor)

Position	Lovel	Dista	nce range
Position Level		cm	inch
Rear	1st	61 ~120 (±15)	24.0 ~ 47.2 (±5.9)
	2nd	31 ~ 60 (±15)	12.2 ~ 23.6 (±5.9)
	3rd	Less than 30 (±10)	Less than 11.8 (±3.9)

# **Horizontal Sensing Area**



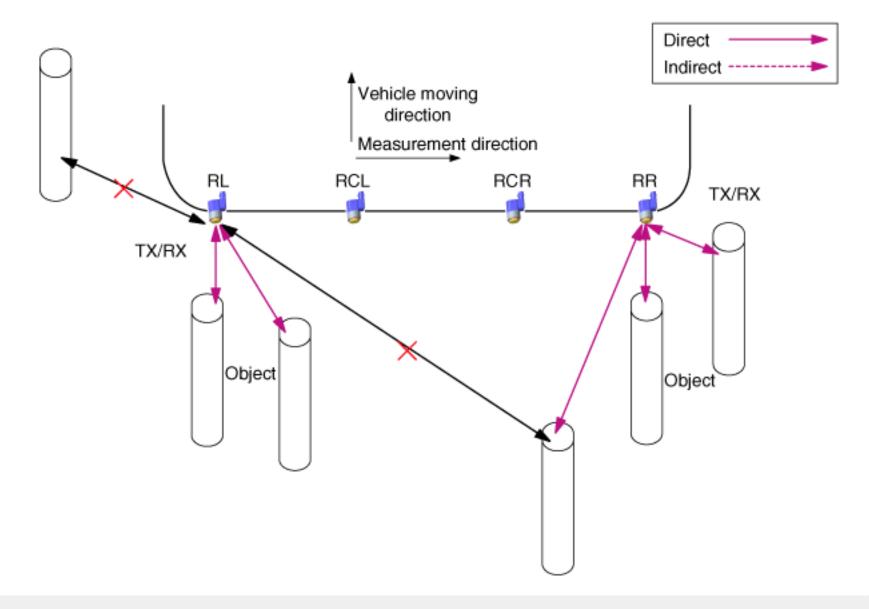
# **Vertical Sensing Area**



### **Distance Measurement**

### **Direct Measurement**

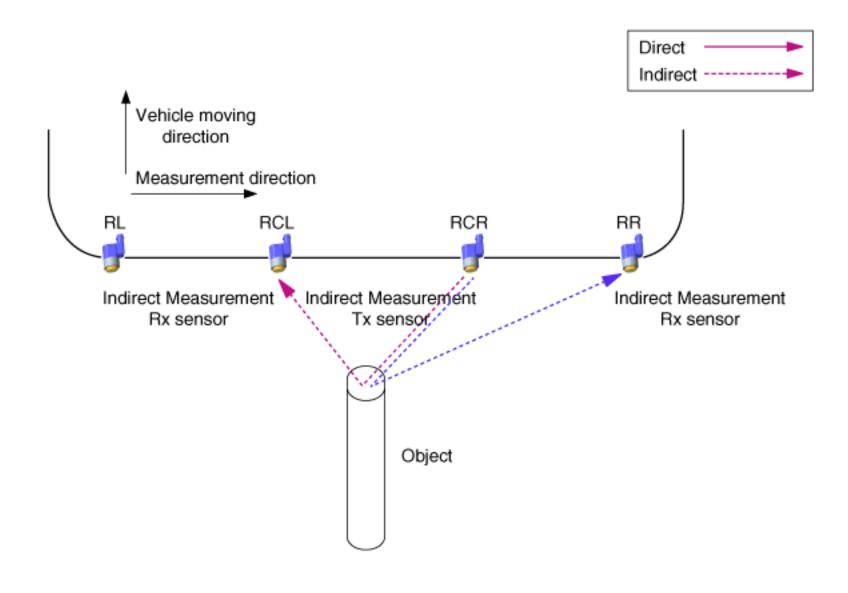
Transmission and Reception are executed with one sensor (RL, RCL, RCR, RR each sensor execution)



#### **Indirect Measurement**

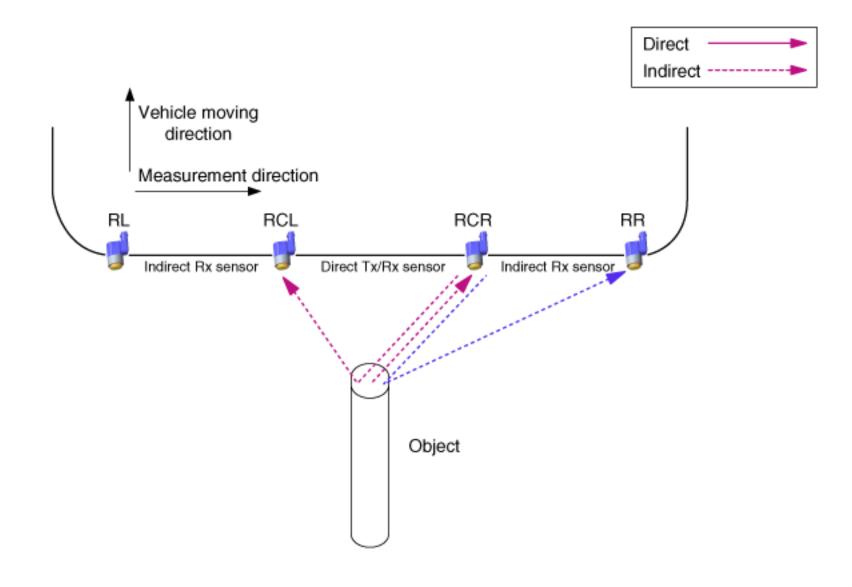
 $(RCL \rightarrow RL, RCL \rightarrow RCR, RCR \rightarrow RCL, RCR \rightarrow RR$  Execution in order)

With two or three sensors, one of them sends the transmission and the others get the reception.



#### **Direct and Indirect Measurement at once**

With two or three sensors, the one sensor performs both transmission and reception, and the others perform only reception.



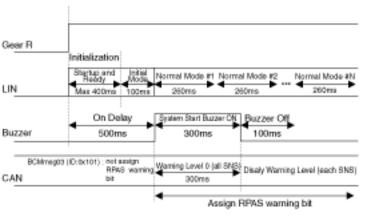
# PAS Alarm System

When the RPAS sensor detects the object, warning is operated by audible alarm device as like buzzer. RPAS sensor sends data to BCM with LIN communication and BCM implements audible warning for each RPAS SENSOR by priority. And it performs a role of gateway only when it sends visible alarm device such as Cluster.

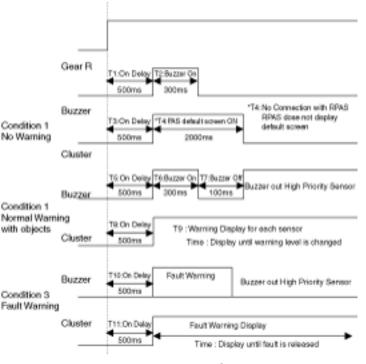
 Sensor buzzer/display information processing method of BCM In case of RL/RR sensor information, the BCM handles each sensor information directly about Display and buzzer output function. Buzzer output of CL/CR sensor, BCM handles center combination information by priority both sensor.

### System Operation Spec

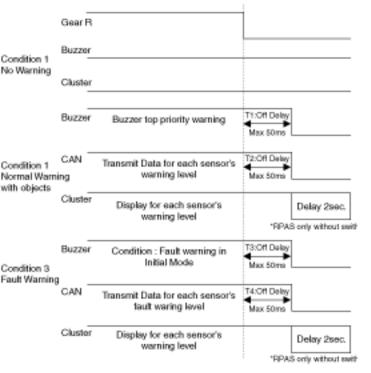
When the system has the power (after IGN ON and R gear), MICOM checks every sensor channel. In case it is not find any error, it sounds 300ms buzzer 500ms afterward. But it finds any error even a sensor, it sounds buzzer corresponding fault sensor instead of initial starting alarm. Function for normal mode entrance is as below



With R Gear, system function is as below



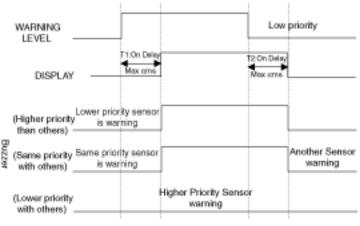
With R gear releasing, system function is as below



\*acceptable error range on waveform ±10%

### Alarm Output Specification Classified By Distance Between Sensors

Condition logic according to priority of alarm level is as below. (the identical sensor)

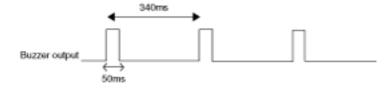


\*α value definition

- 1. low priority sensor off :  $\alpha$  = 0ms
- 2. low priority sensor is 1st warning level :  $\alpha$  < 340ms
- 3. low priority sensor is 2nd warning level :  $\alpha$  < 170ms
- \*β value definition
- 4. low priority sensor is 1st warning level :  $\beta$  = 1700ms
- 5. low priority sensor is 2nd warning level :  $\beta$  = 1700ms
- 6. low priority sensor is 3rd warning level :  $\beta$  = 700ms

Alarm control by sensing distance is as below

7. First warning area (61cm ~ 120cm)



8. Second warning area (31cm ~ 60cm)

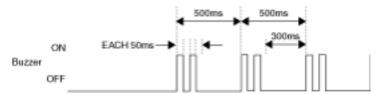


9. Third warning area (less than 30cm)

# Buzzer output——

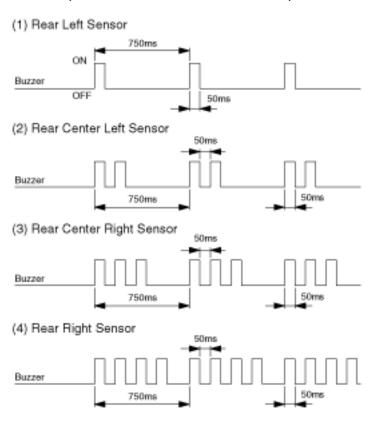
#### 10. Period of fault alarm

(1) With visible display



#### (2) Without visible display

When the system has error channel in initial time, sensor channel let us know the location of error via hearing device. (Three times for each sensor)



### NOTICE

- 1) Time tolerance of the above waveform: Time ± 10%
- 2) At nearer distance than 30cm, detection may not occur.
- 3) Alarm will be generated with vehicle reversing speed 10km/h or less.
- 4) For moving target, maximum operation speed shall be target approach speed of 10km/h.
- 5) When the vehicle or the target is moving, sequential alarm generation or effective alarm may be failed.
- 6) False alarm, or failure of the alarm to trigger may occur in the following conditions.
- Irregular road surface, gravel road, reversing toward grass.
- Horn, motor cycle engine noise, large vehicle air brake, or other object generating ultrasonic wave is near.
- When a wireless transmitter is used near to the sensor.
- Dirt on the sensor.
- Sequential alarm may not occur due to the reversing speed or the target shape.

#### Communication Standard

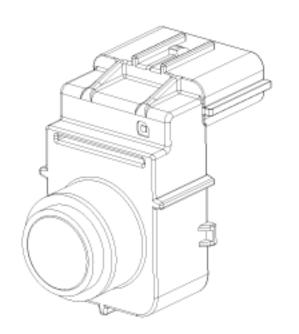
This section defines the communication between RPAS and BCM.

RPAS send a detecting result of object and sensor diagnosis result to BCM according to this document, and BCM takes a role to alarm.

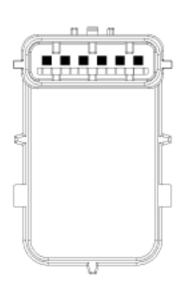
Indicator shows the transmitted position and alarm data, in alarm case, it finds the nearest DATA and alarms the nearest DATA first.

(Ex. In case, RL is first step alarm and RR is third step, RR alarm has priority.)

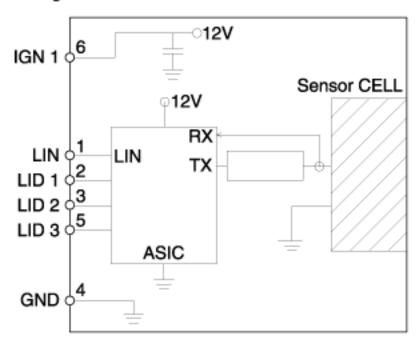
# **COMPONENT**







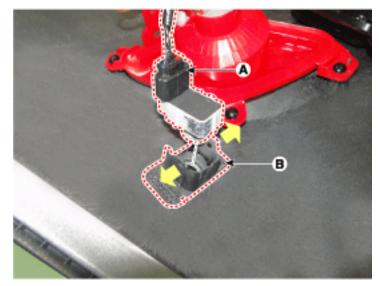
# Circuit Diagram



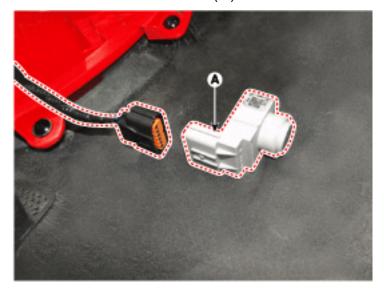
Connector	No.	Description
	1	LIN
	2	LID 1
1 2 3 4 5 6	3	LID 2
	4	GND
	5	LID 3
	6	IGN 1

### **REMOVAL**

- 1. Disconnect the negative (-) battery terminal.
- Remove the rear bumper cover.(Refer to Body "Rear Bumper Cover")
- 3. Pull out the sensor (A) by opening the sensor holder (B) out.



4. Disconnect the connector (A) from the sensors.



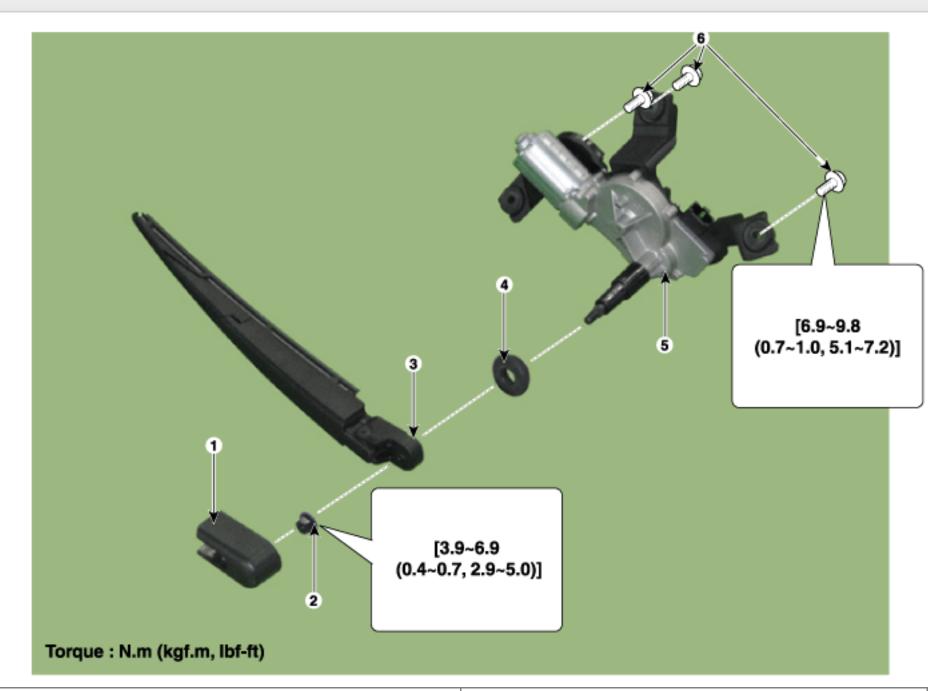
### **INSTALLATION**

- 1. Install the ultra sensor after connecting the connector.
- 2. Install the bumper.

# **SPECIFICATION**

Item		Specification		
	Voltage rating	DC 12 V		
	Detecting range	30 cm ~ 120 cm		
	Operation voltage	DC 9 ~ 16 V		
Ultrasonic sensor	Operation current	MAX 300 mA		
	Operation temperature	-30°C ~ +80°C (-22°F ~ +176°F)		
	Operation frequency	DC 12 V  30 cm ~ 120 cm  DC 9 ~ 16 V  MAX 300 mA  -30°C ~ +80°C (-22°F ~ +176°F)  48 ± 5 KHz		
	Number of sensors	4 (Left side, Left center, Right center, Right side)		

# **COMPONENT LOCATION**



- 1. Head cap
- 2. Rear wiper arm nut
- 3. Rear wiper arm & blade

- 4. Grommat
- 5. Rear wiper motor
- 6. Rear wiper motor bolt

### Front and Rear Washer Motor

1. With the washer motor connected to the reservoir tank, fill the reservoir tank with water.

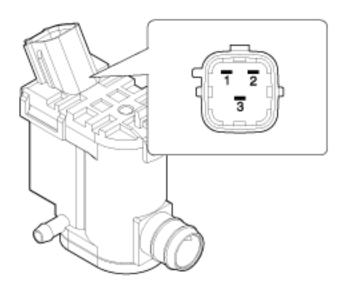
## NOTICE

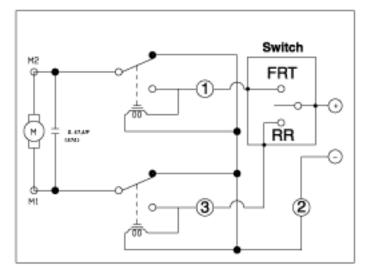
Before filling the reservoir tank with water, check the filter for foreign material or contamination. if necessary, clean the filter.

- 2. Connect positive (+) battery cables to terminal 1 and negative (-) battery cables to terminal 2 respectively.
- 3. Check that the motor operates normally and the washer motor runs and water sprays from the front nozzles.
- 4. If they are abnormal, replace the washer motor.

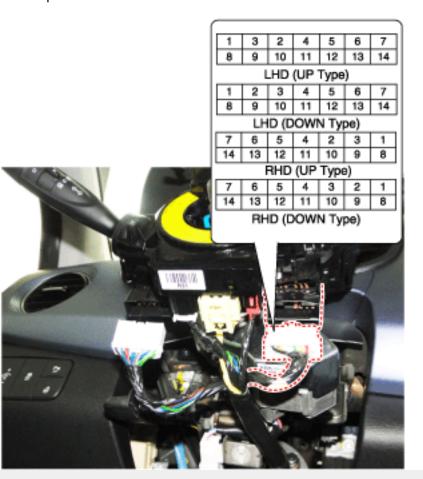
## [Front & Rear washer]

No.	Description
2	Ground
1	Windshield washer (+)
3	Rear washer (+)





Check for continuity between the terminals while operating the wiper and washer switch. If it is not normal condition, replace wiper and wiper switch.



# **Rear Wiper Switch**

Terminal Position	13	11	3
OFF	0		
ON	0		

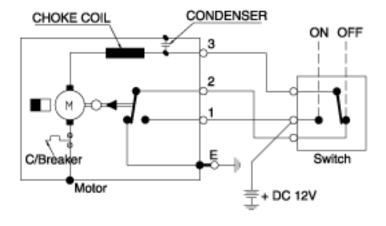
#### **Rear Washer Switch**

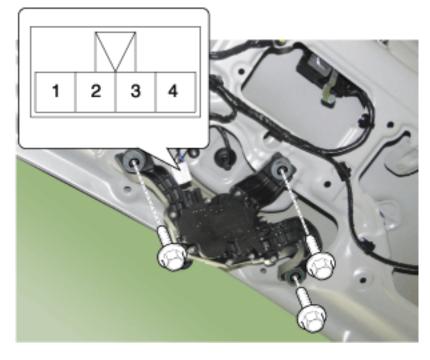
Terminal Position	13	3	12
OFF			
ON	$\overline{\bigcirc}$	<u> </u>	<u> </u>

# Rear Wiper Motor

1. Operate the wiper switch to check for continuity between wiper motor terminals

No.	Description	
1	Switched (+)	
2	Wiper (+), Self-parking	
3	Wiper motor, Input (+)	
4	GND	





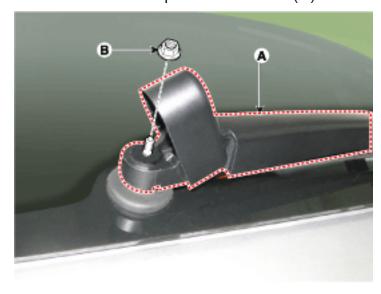
2. Check that the motor operation as below table.

Terminal Position	1	2	3
OFF(Auto stop)		0	
ON	0—		

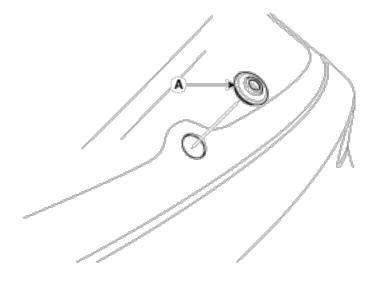
1. Open the rear wiper cap (A).



2. Remove the rear wiper arm & blade (A) after removing rear wiper nut (B).



3. Remove the rear wiper grommet (A).



- 4. Open the tailgate then remove the tailgate trim. (Refer to Body "Tailgate Trim")
- 5. Disconnect the rear wiper motor connector (B) then remove the rear wiper motor (A) after loosening bolts (3EA).



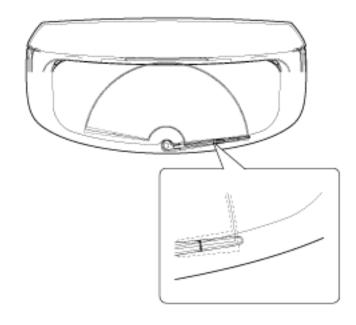
### **INSTALLATION**

1. Install the rear wiper motor assembly and the grommet.

# Tightening torque Bolt :

6.9~9.8 N.m (0.7~1.0 kgf.m, 5.0~7.2 lbf.ft)

- 2. Install the tailgate trim.
- 3. Set the rear wiper blade and to the lowest defogger heat line and tailgate glass.

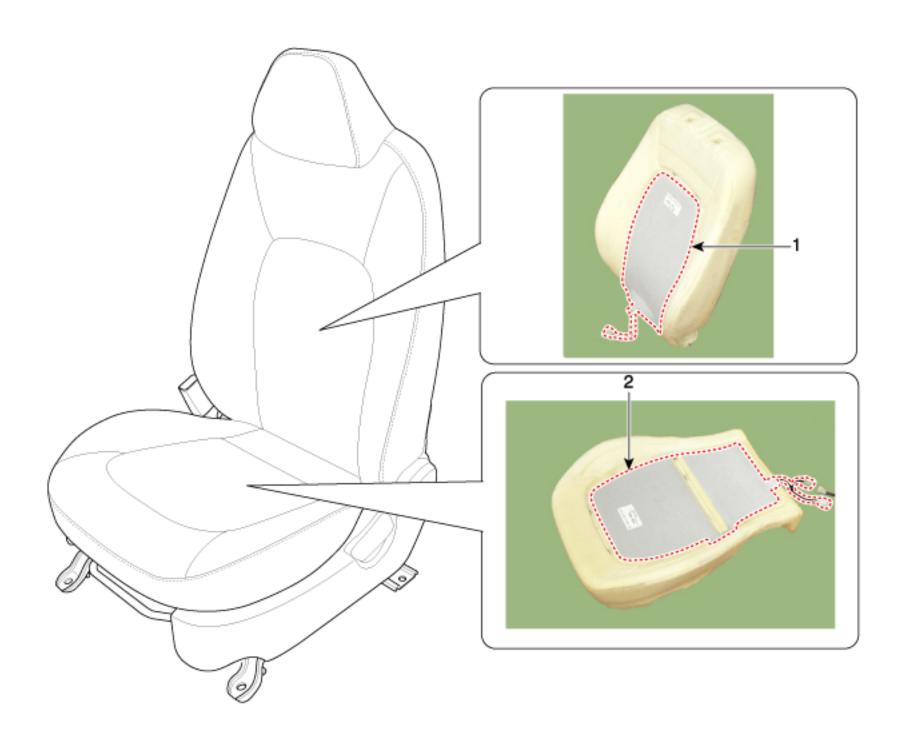


4. Install the rear wiper cap and rear wiper nut.

## **Tightening torque Nut:**

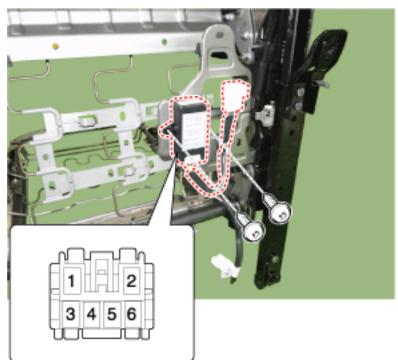
 $3.9 \sim 6.9 \text{ N.m} (0.4 \sim 0.7 \text{ kgf.m}, 2.9 \sim 5.0 \text{ lbf-ft})$ 

# **COMPONENTS**



1. Seat tack heater 2. Seat cushion heater

1. Check for continuity and measure the resistance between terminals.



No.	Description	No.	Description
1	Heater (+)	4	-
2	Heater (-)	5	NTC (-)
3	NTC (+)	6	-

Standard value (Fabric / Leather)

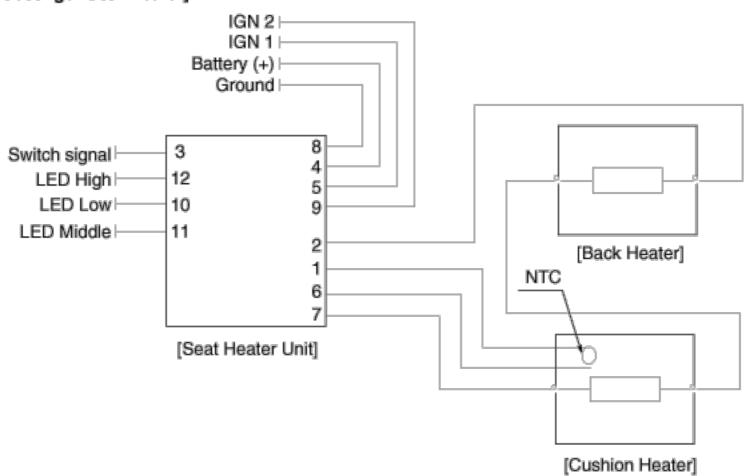
**Cushion**:  $1.34 \Omega \pm 10\%$ **Back**:  $1.05 \Omega \pm 10\%$ **Set**:  $2.39 \Omega \pm 10\%$ 

2. Operate the seat heater after connecting the connector, and then check the thermostat by measuring the temperature of seat surface.

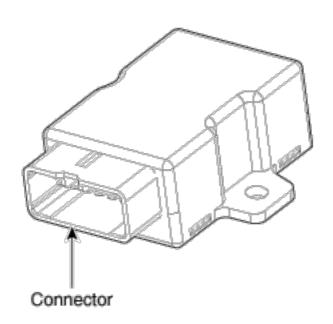
	1st	2nd	3rd
Cushion (±2°C/ ±35.6°F)	36°C (96.8°F)	39°C (102.2°F)	42°C (107.6°F)
Back (±2°C/ ±35.6°F)	40°C (104°F)	45°C (113°F)	50°C (122°F)

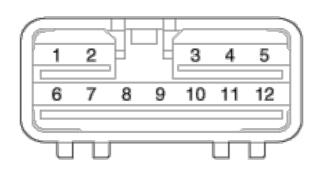
# **CIRCUIT DIAGRAM**

### [Drvier/ Passenger Seat Heater]



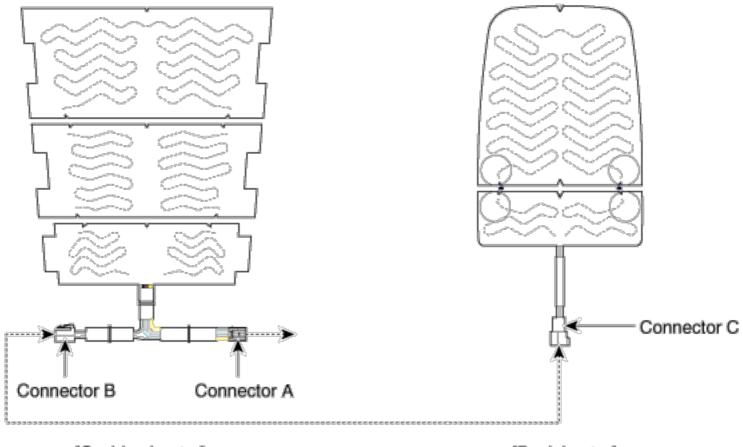
# [Seat Heater Unit]





No.	Description	No.	Description
1	NTC (+)	7	Heater (-)
2	Heater (+)	8	Ground
3	Switch signal	9	IGN 2
4	Battery (+)	10	LED Low
5	IGN 1	11	LED Middle
6	NTC (-)	12	LED High

# [Drvier/ Passenger Seat Heater]



[Cushion heater]

[Back heater]

Connector A	Connector B	Connector C
3 4 5 6	2	

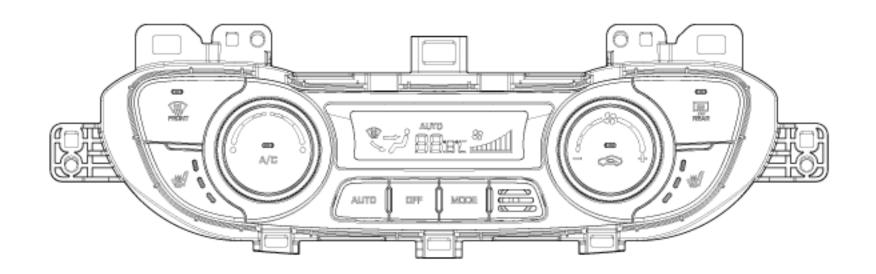
# **REMOVAL**

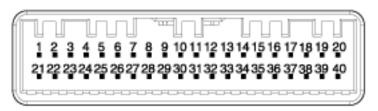
- 1. Disconnect the negative (-) battlery terminal.
- 2. Remove the heater and A/C control unit. (Refer to Heating, Ventilation And Air Conditioning "Heater & A/C Control Unit (DATC)")

### **INSTALLATION**

- 1. Install the heater and A/C control unit.
- 2. Connect the negative (-) battlery terminal.

# **CIRCUIT DIAGRAM**







Connector A

Connector B

No	Description	No	Description
A1	Battery	A21	IGN1
A2	Illumination +	A22	IGN2
A3	-	A23	Sensor ref (+5V)
A4	HTD	A24	Photo sensor -
A5	Rear defog switch	A25	Evaporator sensor +
A6	Detent out +	A26	Ambient sensor +
A7	Mode actuator	A27	K line
A8	Temp actuator	A28	LH seat heater switch
A9	Intake actuator	A29	LH seat heater LED (low)
A10	Mode actuator (vent)	A30	LH seat heater LED (mid)
A11	Mode actuator (def)	A31	LH seat heater LED (high)
A12	Temp actuator (cool)	A32	RH seat heater switch
A13	Temp actuator (warm)	A33	RH seat heater LED (low)
A14	Intake actuator (fre)	A34	RH seat heater LED (mid)
A15	Intake actuator (rec)	A35	RH seat heater LED (high)
A16	-	A36	ECV +
A17	-	A37	ECV -
A18	-	A38	C CAN high

No	Description	No	Description
B1	ISG DC	B4	Blower motor +
B2	FET (gate)	B5	-

Illumination -

GND (sensor)

A39

A40

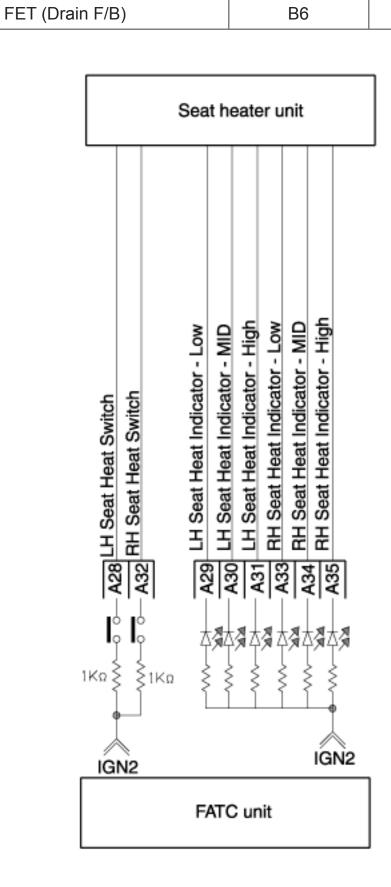
C CAN low

GND

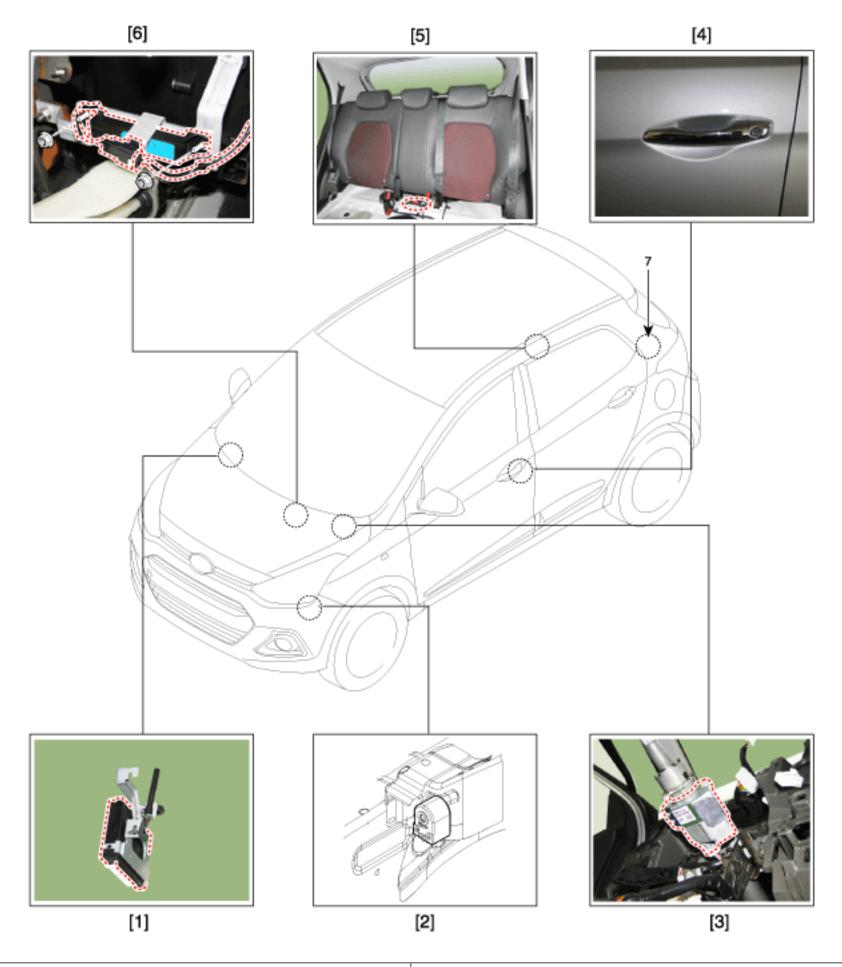
A19

A20

В3



# **COMPONENT LOCATION (1)**



- 1. Smart key unit
- 2. Buzzer
- 3. Electronic steering column lock (ESCL)
- 4. Door outside handle

- 5. Interior antenna 2
- 6. Interior antenna 1
- 7. Bumper antenna

#### **DESCRIPTION**

The SMART KEY system is a system that allows the user to access and operate a vehicle in a very convenient way. To access the vehicle, no traditional key or remote control unit is needed.

The user carries a SMART KEY FOB which does not require any conscious actions by the user (e.g. operate a RKE button). The SMART KEY system is triggered by pressing a push button in the door handle.

After being triggered the vehicle sends out a request in a limited range. If the SMART KEY FOB receives this request, it automatically sends a response to the vehicle. Then the system decides whether to perform a particular action (unlocking, locking...) or remain inactive.

In a similar manner the vehicle's Electrical Steering Column Lock (ESCL) is released. Again, a communication between the vehicle and the SMART KEY FOB is needed before any actions will be performed.

The System offers the following features:

- Passive unlock via door driver side and passenger side
- Passive locking via door driver side and passenger side
- Passive start
- · Passive access trunk via the trunk lid switch at the trunk
- · Passive locking via tailgate
- Max. 2 fobs can be handled by the system
- Immobilizer backup antenna driver integrated into SSB for TP authentication (i.e. limp home mode)
- · Communication with engine management system
- Communication with SRX
- LF-RF communication

#### Passive unlock

The system allows the user to access (unlock) the vehicle without performing any actions with the SMART KEY FOB. This feature could be different depending on platform as follows:

· Pressing Push button in door handle

#### 2. Passive locking

The system allows the user to lock the vehicle by pushing a button on door handle with the SMART KEY FOB.

#### 3. Button start

The system allows the user to release ESCL and to switch the power modes (Off, Accessory, Ignition), as well as to start and stop the vehicle's engine without performing any actions with the SMART KEY FOB. See Button Engine Start system specification.

#### 4. LIMP HOME Mode

Additionally, the system offers so called "limp home mode", which is the user can operate all vehicle functions by pushing the key into the SSB.

# Smart Key ECU (SMK ECU)

The SMK ECU manages all functions related to "Passive Unlock", "Passive Lock" and "Passive Authorization for Engine Start Operation".

It reads the inputs (Push button in door handle, Start Stop Button (SSB), PARK position Switch), controls the outputs (e.g. exterior and interior antennas), and communicates via the CAN as well as a single line interface to further devices of the car.

For communication with the SMART KEY FOB, SMK ECU generates a request (challenge) as an encoded and modulated 125 (or 134.2) kHz signal at the inductive antenna outputs and receives the SMART KEY FOB's response via the external RF receiver.

The main functional blocks of the SMK ECU are:

- Power supply
- Microcontroller with FLASH Memory
- Single Line Interface to SRX
- Single Line Interface to EMS
- Input stage
- LF antenna amplifier/driver
- CAN communication with BCM

The LF antenna amplifier/driver generates a 125 (or 134.2) kHz sinusoidal carrier signal which is distributed to the different antennas.

### **Smart Key FOB**

The system supports up to 2 SMART KEY FOBs.

The main functions of the SMART KEY FOB are:

- Passive functionality: receives LF-challenge and sends automatically RF response.
- Classic RKE function by action up to 4 push buttons.
- Transponder-functionality in case of a flat battery or a disturbed communication.

#### **Antennas**

1. Emitting LF Antennas:

Inductive antennas in and at the vehicle are used to transform the current, driven by the SMK ECU antenna driver, into a 125 (or 134.2) kHz magnetic field, which is the carrier for the SMART KEY challenge.

Three antennas cover the vehicle's exterior: two antennas in the Door Handles (DS and PS) cover the area around the doors; one antenna in the rear bumper covers the area around the trunk or tailgate.

Up to three antennas cover the vehicle's interior and the trunk or tailgate interior: two in the passenger compartment and one in the tailgate room or trunk.

2. Bidirectional Immobilizer Antenna (for Limp Home):

The Immobilizer Backup Antenna is used for sending and receiving data: it emits a magnetic field (125 - 135 kHz challenge) and receives changes in the field strength (response of Transponder).

3. External Receiver

The SMART KEY FOB's response is received via the external RF receiver, which is connected to the SMK ECU via a serial communication Line.

The SMK ECU provides a connector pin for the serial communication Line.

#### **Door Handle**

The front door handles of the two doors (driver door / passenger door) are equipped with emitting LF-antennas to emit the 125 (or 134.2) kHz signals. The front door handles are also equipped with a push button.

#### **Push Button**

The push button in door handle serves as a trigger to indicate the user's intent to unlock or lock the vehicle.

The push buttons are installed at front doors, integrated into the door handles.

Another button is installed at the trunk or tailgate lid.

#### **OPERATION**

#### **Passive Functions**

The system allows the user to access the vehicle without having to perform any actions (e.g. RKE button pressing) with the SMART KEY FOB. It is sufficient that a valid SMART KEY FOB is located within a defined and limited range with respect to the vehicle. So the system is capable of detecting and authenticating a SMART KEY FOB in the ranges as specified below.

#### **Operating Range**

The SMART KEY FOB receives and interprets a challenge sent from the vehicle via the exterior antennas in a free space range of min. 0.7m measured around the exterior antennas which are integrated in the door handles; refer to the below given picture. The trunk or tailgate access range is also min. 0.7m measured from the antenna position.

The SMART KEY FOB receives and interprets a challenge sent from the vehicle via the exterior antennas in a free space range of min. 0.7m measured around the exterior antennas which are integrated in the door handles; refer to the below given picture

### Passive Access (Passive Entry)

Pressing one of the push buttons in the door handles when all doors locked indicates the operator's intent to access the vehicle and thus triggers the system for unlock

# Passive Locking (Exit)

Pressing one of the push buttons in the door handles when one of the following condition is fulfilled:

- At least one door is unlocked and two\_steps timer is not running or
- Two\_steps timer is running and one of the push button except Front Left side is triggered

indicates the operator's intent to lock the vehicle and thus triggers the system for a lock.

### Passive Open Tailgate

Pressing the Trunk/Tailgate Lid Switch when Trunk/Tailgate is closed indicates the operator's intent to open the Trunk/Tailgate and thus triggers the system. Subsequently, the SMK ECU sends a LF-challenge to the SMART KEY FOB via the exterior bumper antenna. The SMART KEY FOB answers with a RF-response. If the received response matches the expected answer, SMK ECU sends a "Trunk/Tailgate open" message via the CAN network.

### Passive Trunk Warning (Sedan only)

Whenever the trunk is closed, SMK ECU uses a suitable search strategy to avoid trunk buzzer warning by a fob outside the vehicle. Then SMK searches for a SMART KEY FOB in the interior of the trunk. If a valid SMART KEY FOB is found in the trunk, the SMK ECU activates SMK external buzzer (TBD) to inform the user that the trunk has been closed with a fob inside the trunk. SMK will send the trunk open command to BCM for trunk reopening if trunk reopening bit is set(BK)For this functionality, a "valid" SMART KEY FOB means any SMART KEY FOB that belongs to the vehicle, even if it's DEACTIVATED.

### NOTICE

- A blind spot in the trunk similar to any RF disturbance may lead to no trunk warning. Due to the penetration of the bumper antenna into the trunk area the lid may open without an Identification Device outside.
- A blind spot in the trunk similar to any RF disturbance may lead to no trunk warning

### Smart Key Reminder 1

1. Preconditions:

All terminals OFF & at least one door open & locking status is not locked checked by SMK periodically every 100ms, as long as CAN/LIN active.

2. Event:

At least 1 door knob status changed from unlock to lock.

- 3. SMK actions:
  - IF NO FOB-IN ACTIVE
     SMK performs a search for the fobs in the interior of the vehicle. The same LF-strategy has to be used as it is defined for the ID out warning (registering only, no authentication
  - IF FOB-IN ACTIVE SMK search valid TP

If no fob or no TP has been found, no action is required.

If any valid fob or valid TP has been found, SMK unlocks the vehicle by sending a CAN Key Reminder unlock message with the fob number.

If any valid fob has been found, SMK unlocks the vehicle by sending a CAN/LIN Key Reminder unlock message with the fob number.

### Smart Key Reminder 2

1. Preconditions:

All terminals OFF & any door (including trunk) open & no FOB-IN & no locking status (checked by SMK periodically every 100ms, as long as CAN/LIN active)

2. Vehicle action:

Closing last door or trunk with knobs locked state, or with a locking in progress

3. SMK actions:

Before elapsing 500ms after the closing if all doors are locked then:

IF NO FOB-IN ACTIVE

SMK performs a search for the fobs in the interior of the vehicle.

The same LF-strategy has to be used as it is defined for the ID out warning (registering only, no authentication)

 IF FOB-IN ACTIVE SMK search valid TP

If no fob has been found, no action is required.

If any valid fob or valid TP has been found, SMK sends unlock command via CAN and activates ext. buzzer warning. If any valid fob has been found, SMK sends unlock command via CAN/LIN and activates ext. buzzer warning.

### Smart Key Door Lock Warning

### Door Lock Warning 1

- 1. If terminal state is ACC or IGN and all doors are closed and that user triggers a SMK lock, a search is started at the exterior of the vehicle from the side of the trigger.
- 2. If no valid Fob is found no action is required, but if a valid Fob is found then a Buzzer warning shall be started.
- 3. If "b\_TailgateOption == On" and "b\_TailgateLockUnlockOption == On" are fullfilled, Lock warning is including tailgate as a door and tailgate lockunlock knob as a door unlock switch.

### **Door Lock Warning 2**

- 1. If terminal state is OFF and not all doors are closed and that user triggers a SMK lock, a search is started at the exterior of the vehicle from the side of the trigger.
- 2. If no valid Fob is found no action is required, but if a valid Fob is found then a Buzzer warning shall be started.
- 3. If "b\_TailgateOption == On" and "b\_TailgateLockUnlockOption == On" are fullfilled, Lock warning is including tailgate as a door and tailgate lockunlock knob as a door unlock switch.

### **Door Lock Warning 3**

- 1. If terminal state is OFF and ATWS is considered as Disarmed and all doors are closed and that user triggers a SMK lock, a search is started at the Interior of the vehicle;
- 2. if no valid Fob is found the search for SMK locking will be started, but if a valid Fob is found then a Buzzer warning shall be started.
- 3. If "b\_TailgateOption == On" and "b\_TailgateLockUnlockOption == On" are fullfilled, Lock warning is including tailgate as a door and tailgate lockunlock knob as a door unlock switch.

### Smartkey Lamp Warning

- 1. If terminal state is ACC or IGN and vehicle speed is less than 3km/h, a periodic search (every 3s) is done at the interior of the vehicle to check that the valid fob is still in the in the vehicle.
- 2. If no valid Fob is found a Warning is started, but if a valid Fob is found then no action is started.

### Failsafe Functions (Backup For Limp Home)

In case of a discharged battery of the SMART KEY FOB or disturbed transmission, the following functions are available:

• Unlocking / locking of doors or trunk (or tailgate depending of the vehicle configuration): use of mechanical key

#### **User Information Functions**

#### **ID OUT Warning**

- 1. Preconditions:
  - (ACC or IGN1) & (any door open or trunk open)
- 2. Event:

The last opened door is closed

3. SMK action:

SMK searches for a SMART KEY FOB in the interior.

- If no valid SMART KEY FOB is found, the SMK activates external buzzer and also sends ID OUT warning via CAN (exterior buzzer warning and internal buzzer warning).
- If a door is opened and closed again during terminals on and inside valid fob, SMK re-enables the authentication and stops the warning. If the terminal is in ACC, SMK shall turn on immobilizer lamp.

### NOTICE

If there is a LF error (LF overheating or LF antenna failure), the system will have the same behavior as it is with no fob found.

### **Fob Battery Low Voltage Detection**

To detect fob low battery condition, certain battery voltage measurement and low voltage detection strategy are implemented into fob. The measurement of the battery voltage will be done if fob button is pressed or if a LF measurement command is received.

### **Learning Description**

In this chapter, the learning procedure for SMK, ESCL and FOBs is described.

For the learning of the SMK, ESCL and FOBs, it's necessary to have a connection to the diagnostic tool.

### Learning MODE

Whatever the mode, the learning procedures are managed by the SMK.

Prior to start learning service, Fob-In signal must be active and the vehicle secret code (called as PIN code) should be known.

### Teaching MODE

This mode is used by the dealers in order to replace SMK and/or ESCL and/or the set of keys, or to register additional keys for an existing system. That means the system already has been learnt with certain PIN Code. The PIN Code is fixed for the life time of the vehicle, therefore the same PIN Code must be used in this mode. Otherwise learning will be failed

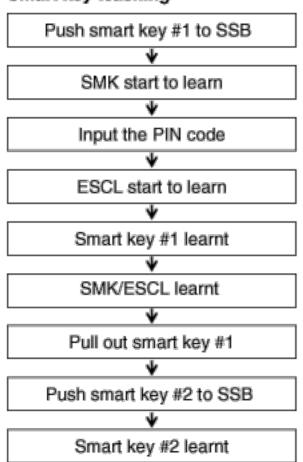
### Teaching MODE Procedure Description (Step By Step)

Objective: Key teaching procedure at service station

Initial state:

- SMK replacement: SMK is not learnt and ESCL and SMART FOB are already learnt with same PIN code
- ESCL replacement: ESCL is not learnt, SMK and SMART FOB are already learnt with same PIN code
- Additional or new keys teaching: SMK and ESCL are already learnt with same PIN code

#### Smart key teaching



 Smart key system is learnt transponder and smart key by once at same time.

#### <Smart key neutralization mode>

- Neutralization mode is for replacing Smart key unit, ESCL, ECM easily.
- It is possible that smart key is learnt again, after neutralizing Smart key system.
- Virgin start (twice ignition) is impossible in neutralized condition

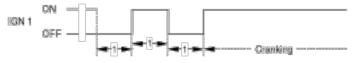
#### <Lock by timer>

 If PIN code is inputted over 3 times, it is impossible to learnt and neutralization during 1 hour.

# Starting After Replacing (Virgin Start)

Starting is possible by following process after replacing new smart key unit, FOB key or ESCL.

- It is for starting at virgin condition
- All related parts are virgin condition (Smart key, ESCL ECM)
- ESCL is always unlock at virgin
- Press brake pedal in P or N range
- Push the start button once with virgin smart key.



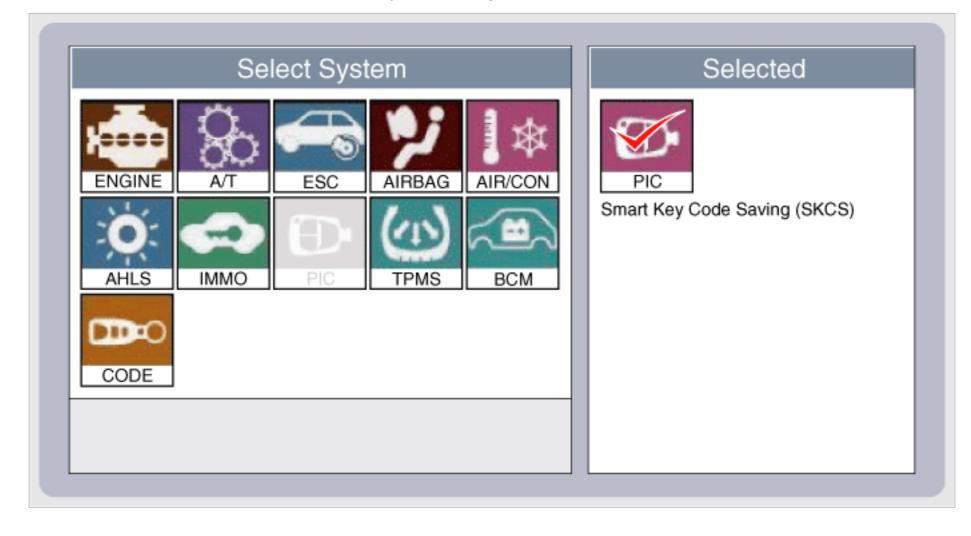
### **SMART KEY**

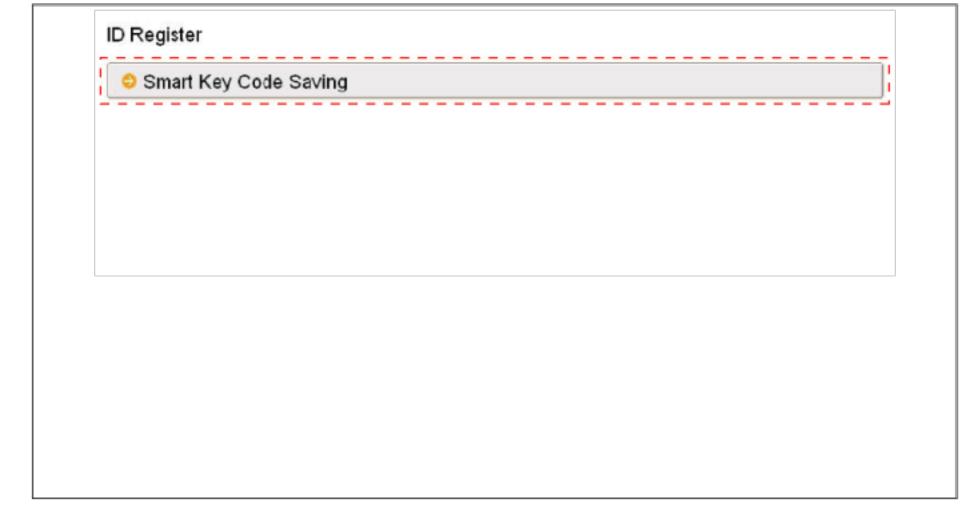
# **Smart Key Code Saving**

1. Connect the DLC cable of GDS to the data link connector (16 pins) in driver side crash pad lower panel, turn the power on GDS.

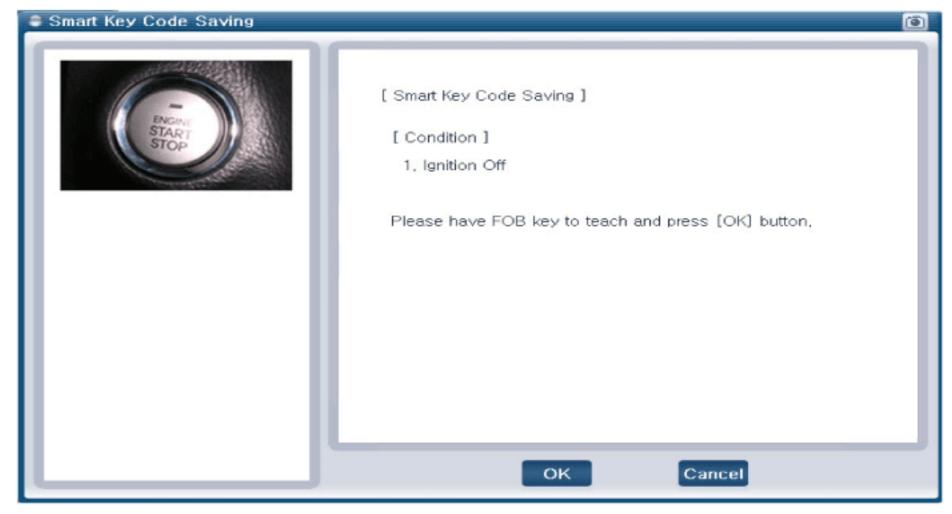


2. Select the vehicle model and then do "Smart key code saving".

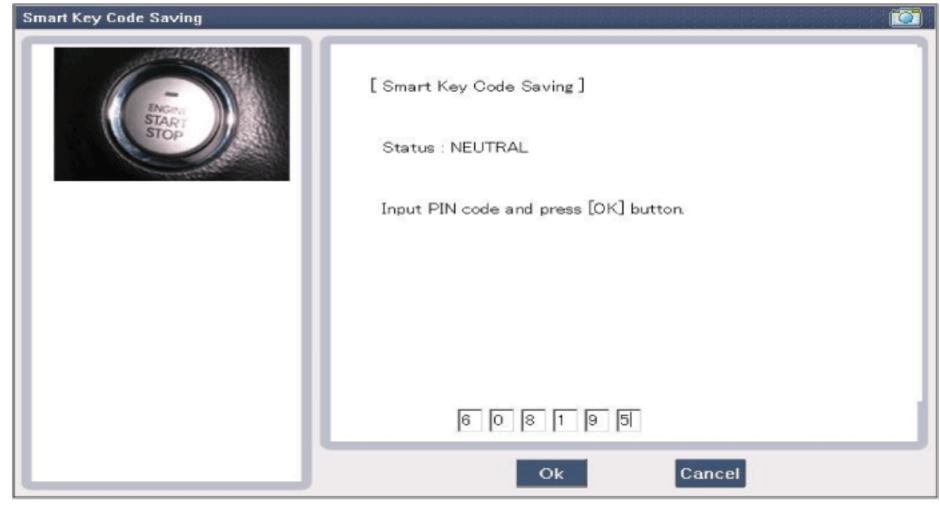


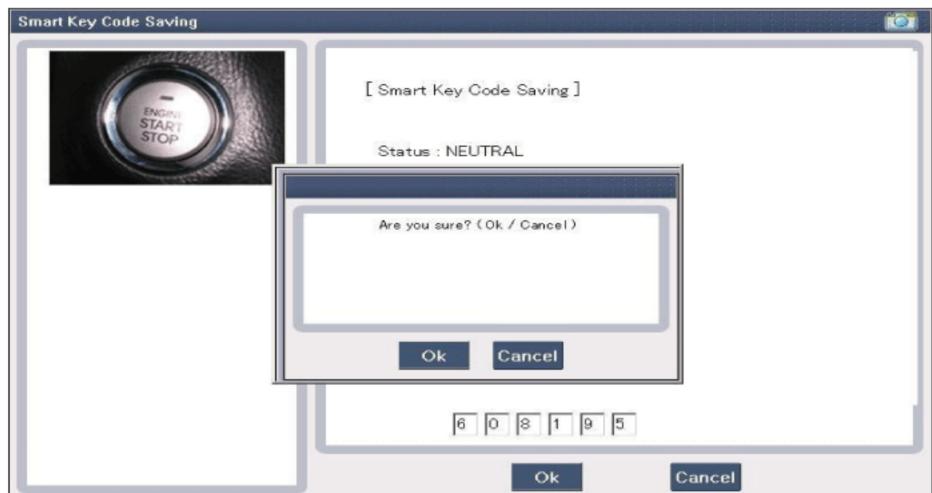


3. After selecting "Smart key teaching" menu, push "Enter" key, then the screen will be shown as below.

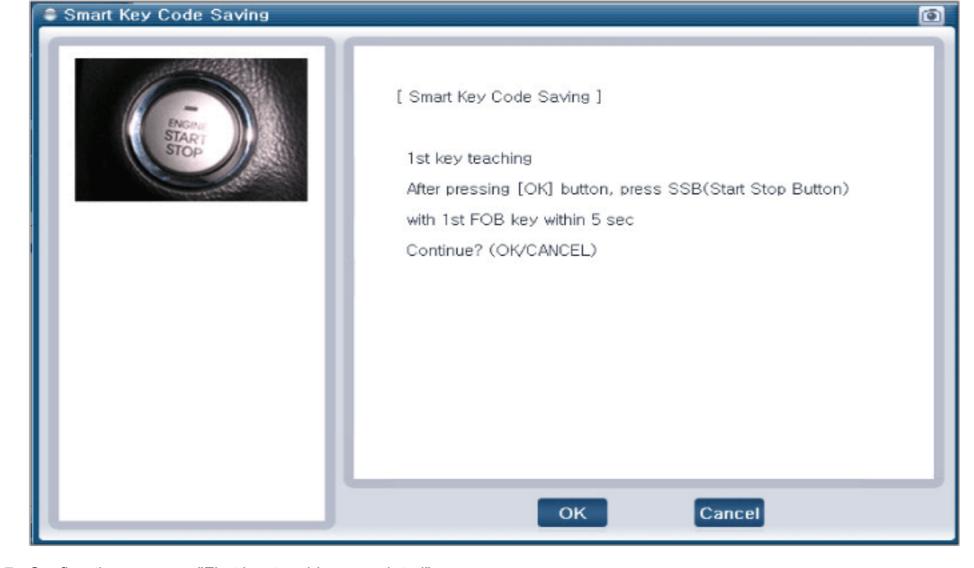


- 4. After having the teaching smart key, push "ENTER" key.
- 5. Input the "Pin code" for first key teaching.

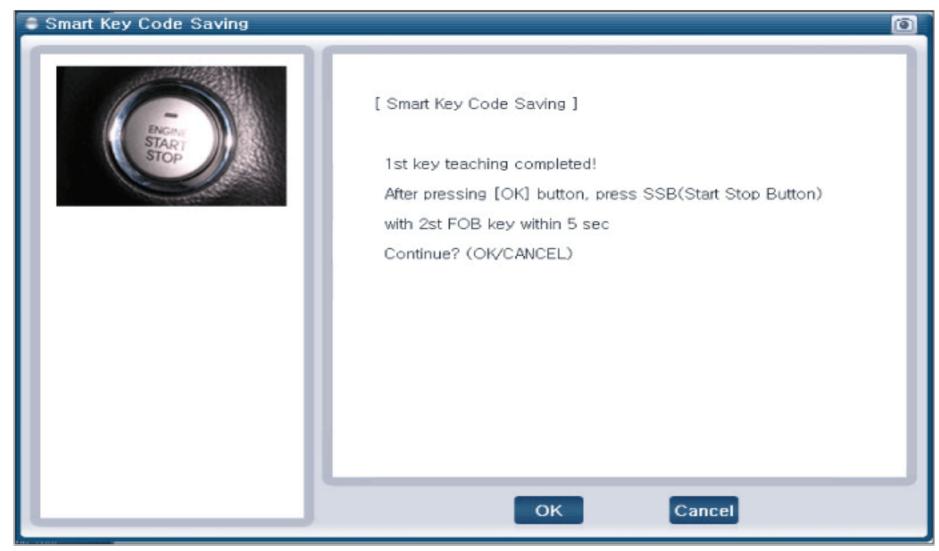




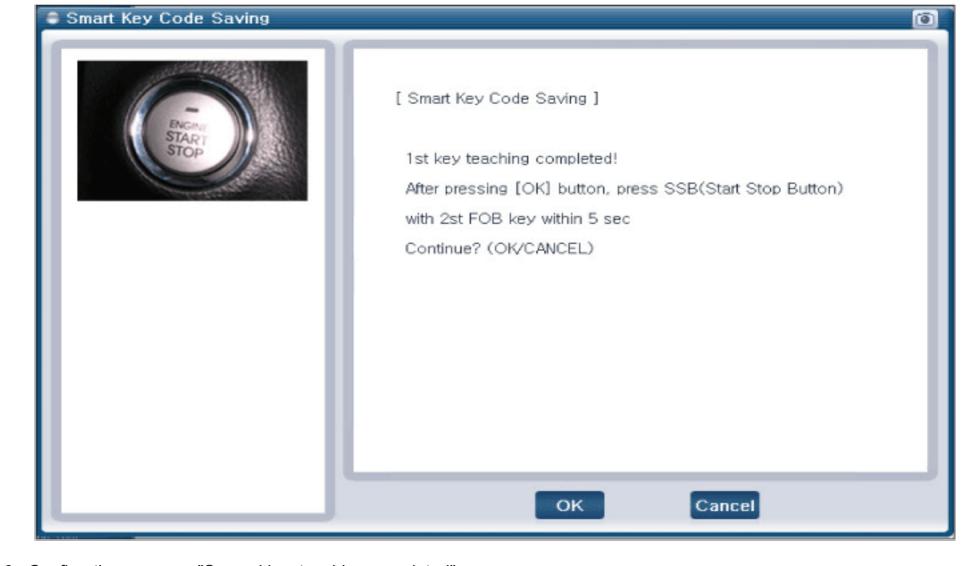
6. Press the SSB with smart key within 5 sec after pressing "OK".



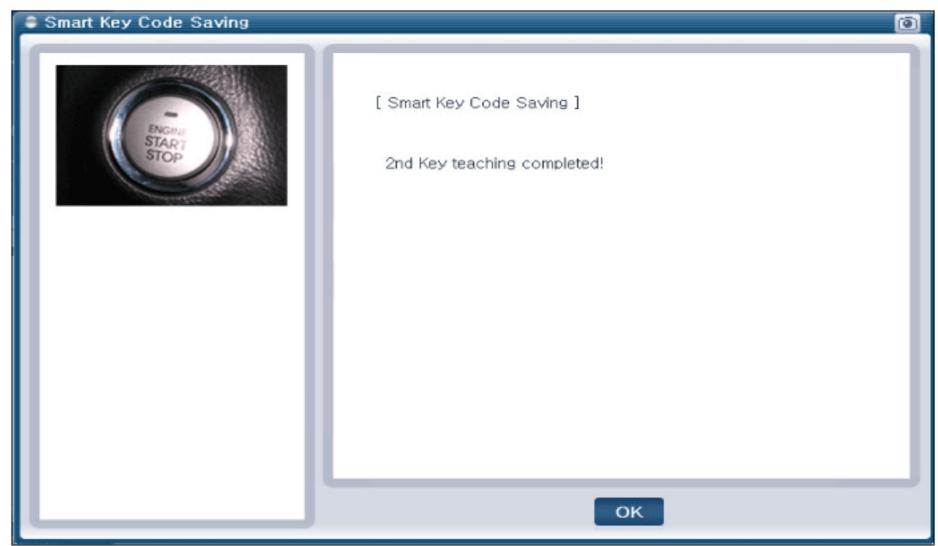
7. Confirm the message "First key teaching completed".



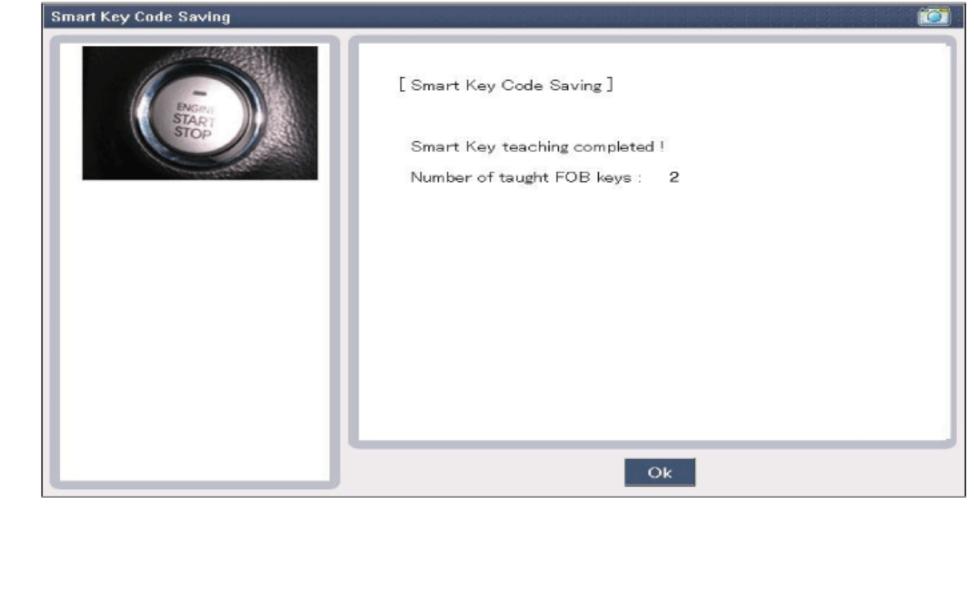
8. Press the SSB with smart key within 5 sec after pressing "OK".



9. Confirm the message "Second key teaching completed".



10. Then the screen will be shown as below when key teaching process is completed.



#### INSPECTION

### Self Diagnosis With GDS

Smart key system defects can be quickly diagnosed with the GDS. GDS operates actuator quickly to monitor, input/output value and self diagnosis.

The following three features will be major problem in SMART KEY system.

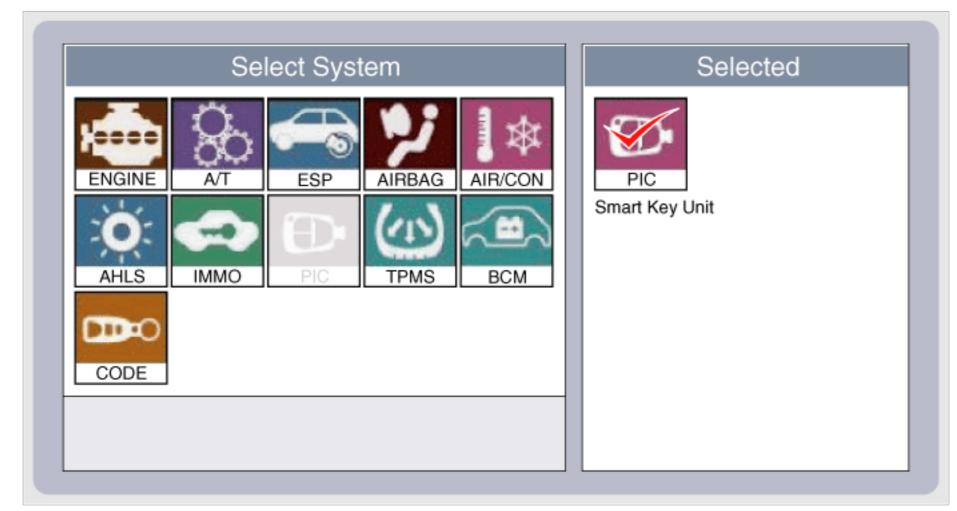
- 1. Problem in SMART KEY unit input.
- 2. Problem in SMART KEY unit.
- 3. Problem in SMART KEY unit output.

The following three diagnostic solutions will be the main solution process to a majority of concerns.

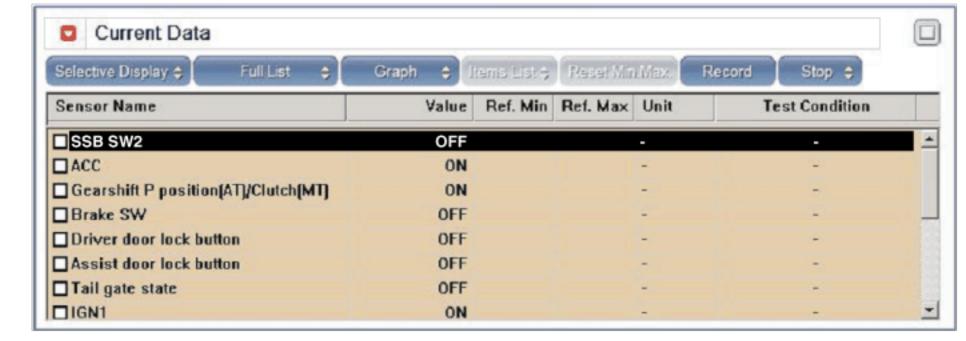
- 4. SMART KEY unit Input problem: switch diagnosis
- 5. SMART KEY unit problem: communication diagnosis
- 6. SMART KEY unit Output problem: antenna and switch output diagnosis

#### Switch Diagnosis

- 1. Connect the cable of GDS to the data link connector in driver side crash pad lower panel, turn the power on GDS.
- 2. Select the vehicle model and then SMART KEY system.



- 3. Select the "SMART KEY unit".
- 4. After IG ON, select the "Current data".



5. You can see the situation of each switch on scanner after connecting the "current data" process.

Display	Description
FL Toggle switch	ON : Push button is ON in the driver door handle.
FR Toggle switch	ON : Push button is ON in the assist door handle.
Trunk switch	ON : Trunk button is ON.
Gear P Position	ON : Shift lever is P position.
IGN 1	ON : IGN switch is IG position.
ACC	ON : IGN switch is ACC position.
Push Knob switch	ON : Push knob switch is ON.
External Buzzer	ON : Buzzer is ON.

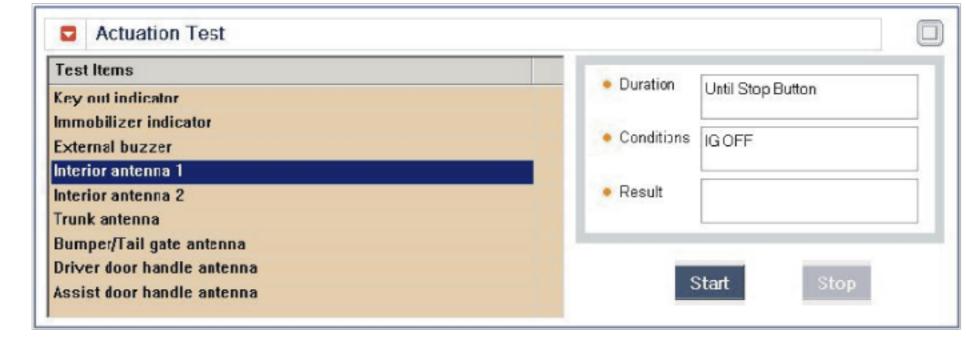
### Communication Diagnosis With GDS (Self Diagnosis)

- 1. Communication diagnosis checks that the each linked components operates normal.
- 2. Connect the cable of GDS to the data link connector in driver side crash pad lower panel.
- 3. After IG ON, select the "DTC".



### **Antenna Actuation Diagnosis**

- 1. Connect the cable of GDS to the data link connector in driver side crash pad lower panel.
- 2. After IG ON, select the "ACTUATION TEST".



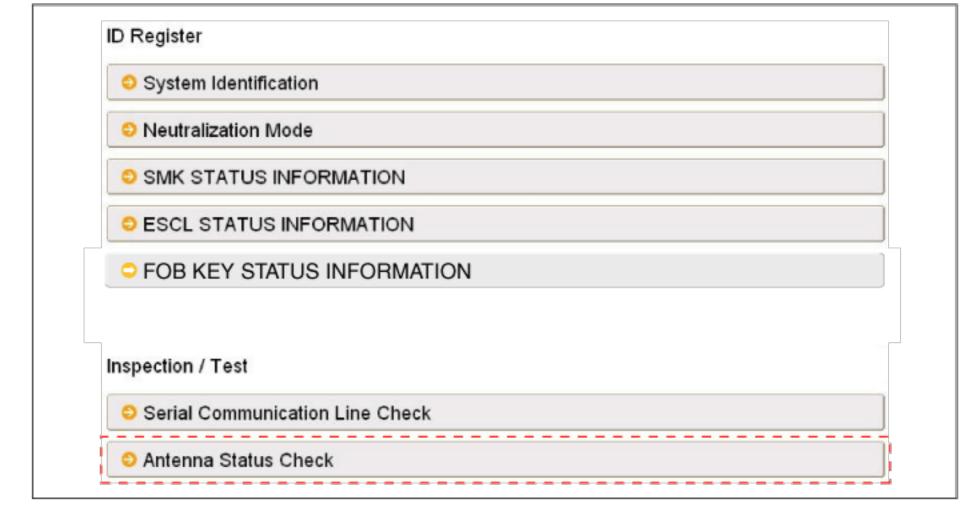
3. Set the smart key near the related antenna and operate it with a GDS.



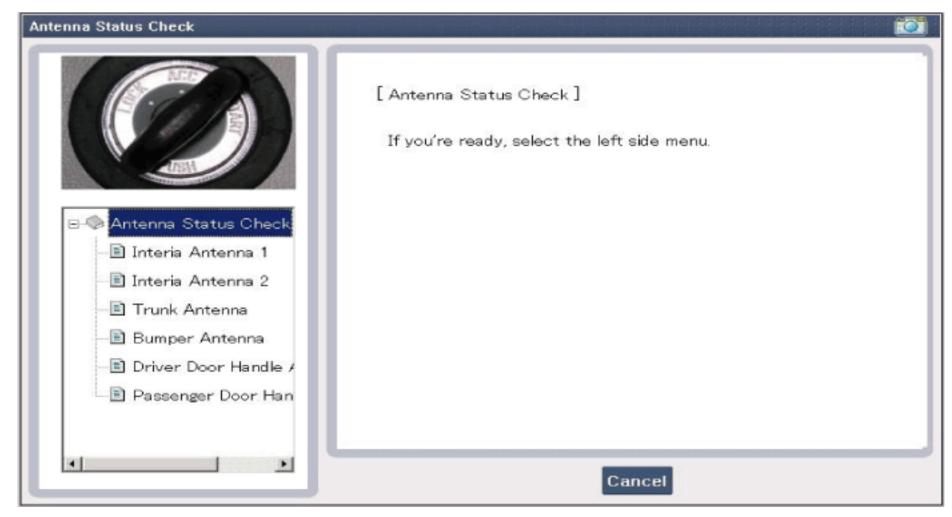
- 4. If the LED of smart key is blinking, the smart key is normal.
- 5. If the LED of smart key is not blinking, check the voltage of smart key battery.
- 6. Antenna actuation
  - INTERIOR Antenna 1
  - INTERIOR Antenna 2
  - Trunk antenna
  - BUMPER/Antenna
  - DRV\_DR Antenna
  - AST\_DR Antenna

#### **Antenna Status Check**

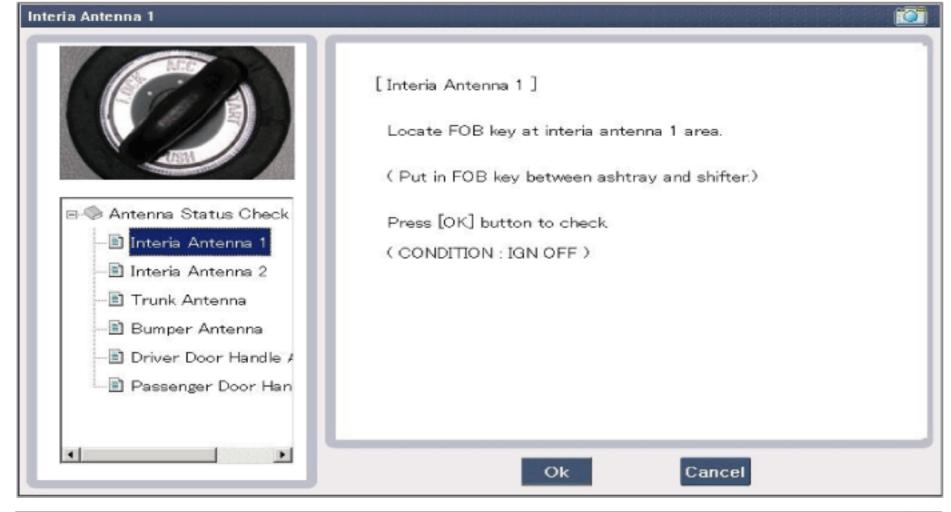
- 1. Connect the cable of GDS to the data link connector in driver side crash pad lower panel.
- 2. Select the "Antenna Status Check".

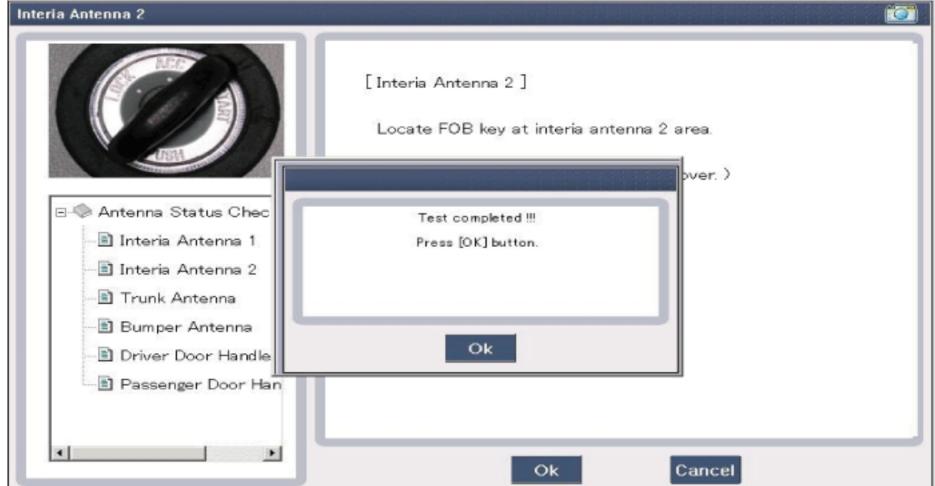


3. After IG ON, select the "Antenna Status Check".



4. Set the smart key near the related antenna and operate it with a GDS.

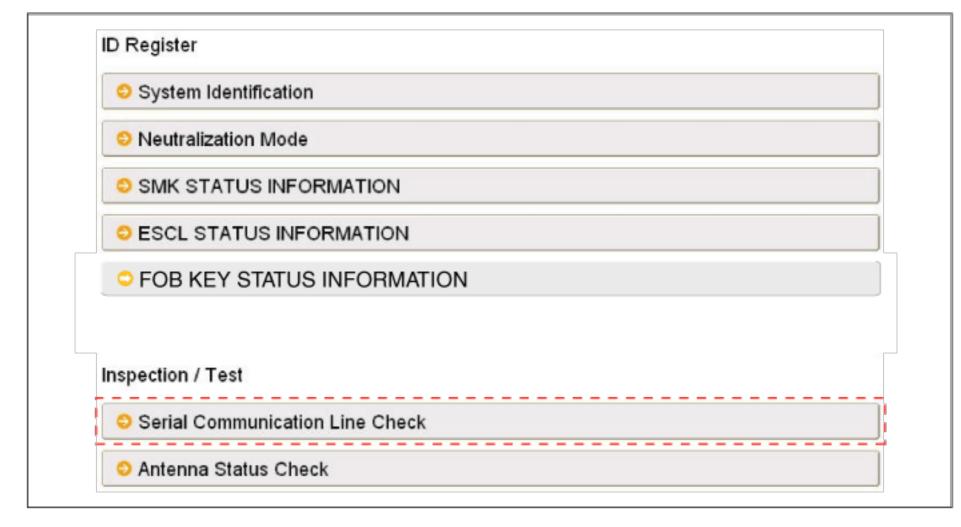




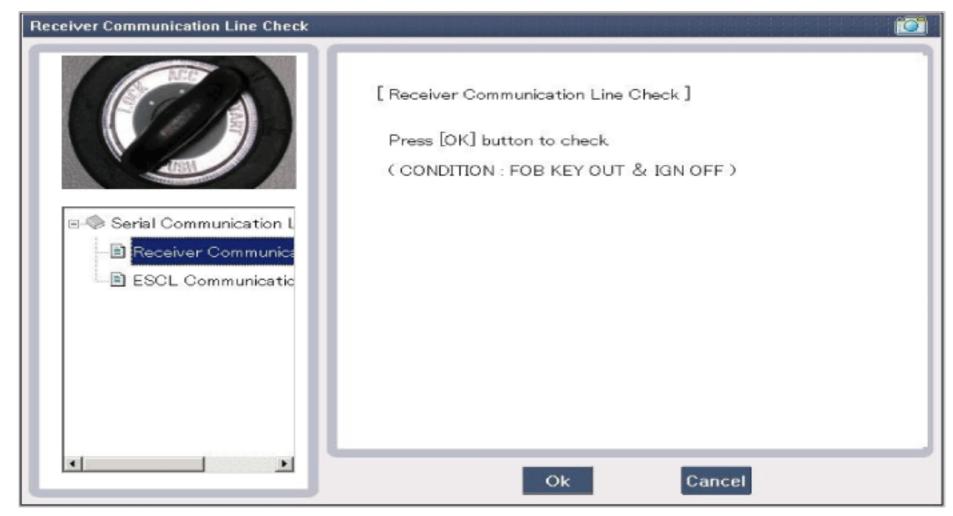
- 5. If the smart key runs normal, the related antenna, smart key(transmission, reception) and exterior receiver are normal.
- 6. Antenna status
  - INTERIOR Antenna 1
  - INTERIOR Antenna 2
  - Trunk antenna
  - BUMPER/Antenna
  - DRV\_DR Antenna
  - AST\_DR Antenna

#### Serial Communication Status Check

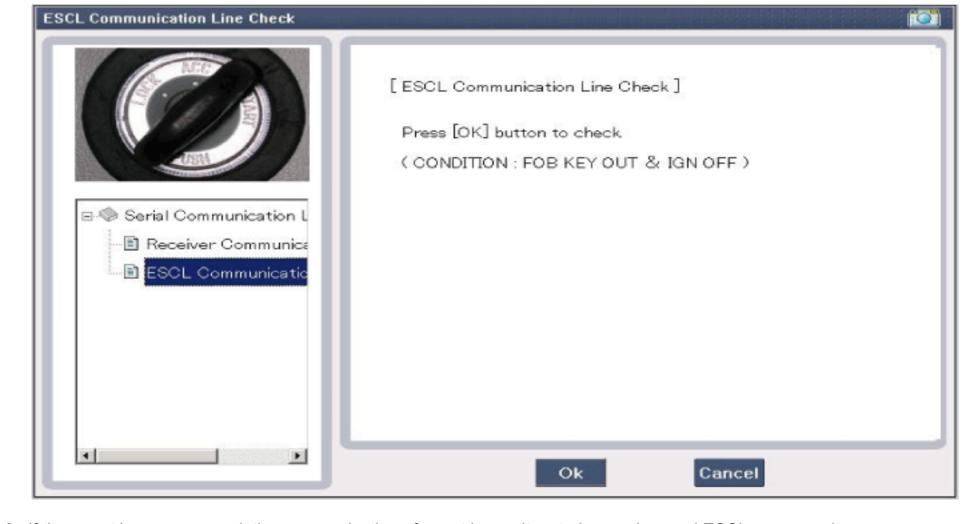
- 1. Connect the cable of GDS to the data link connector in driver side crash pad lower panel.
- 2. Select the "Serial Communication Line Check".



3. After IGN ON, select the "Receiver Communication Line Check".



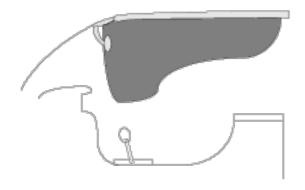
- 4. Check the serial communication line with a GDS.
- 5. If the receiver communication line runs normal, check the "ESCL Communication Line Check".



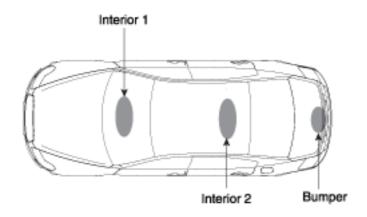
- 6. If the smart key runs normal, the communication of smart key unit, exterior receiver and ESCL are normal.
- 7. If the smart key runs abnormal, check the following items.
  - Disconnection or no response of the exterior receiver communication line.
  - The exterior receiver communication line disconnection and ground connection.
  - The ESCL disconnection or no response
  - The ESCL disconnection and ground connection

### **Interior Antenna Actuation Check**

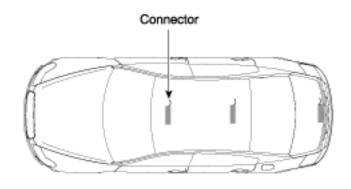
1. Set the smart key in the following shade area and check the IG ON.



- 2. If the ignition is ON, the antenna runs normal.
- 3. Check the interior antenna ignition mode.
- 4. Set the smart key in the following shade area and actuate the antenna. Check the LED of smart key is blinking.

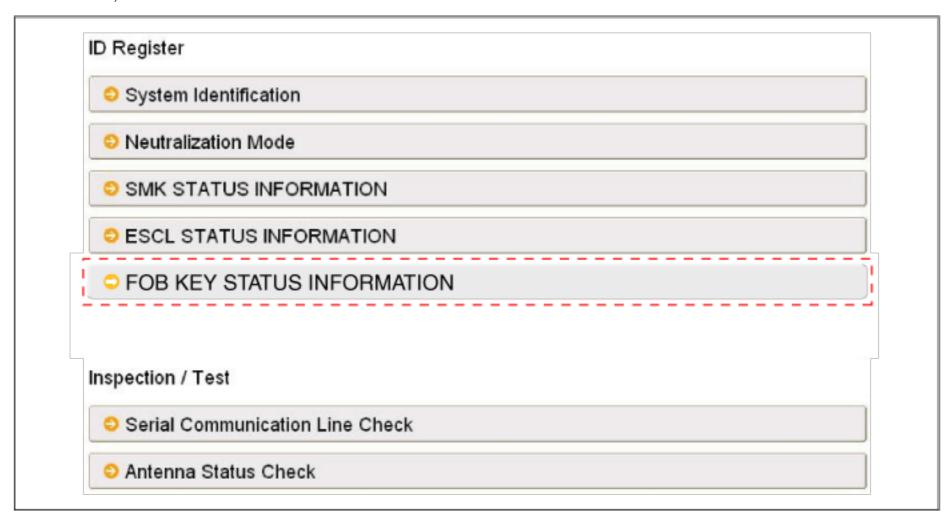


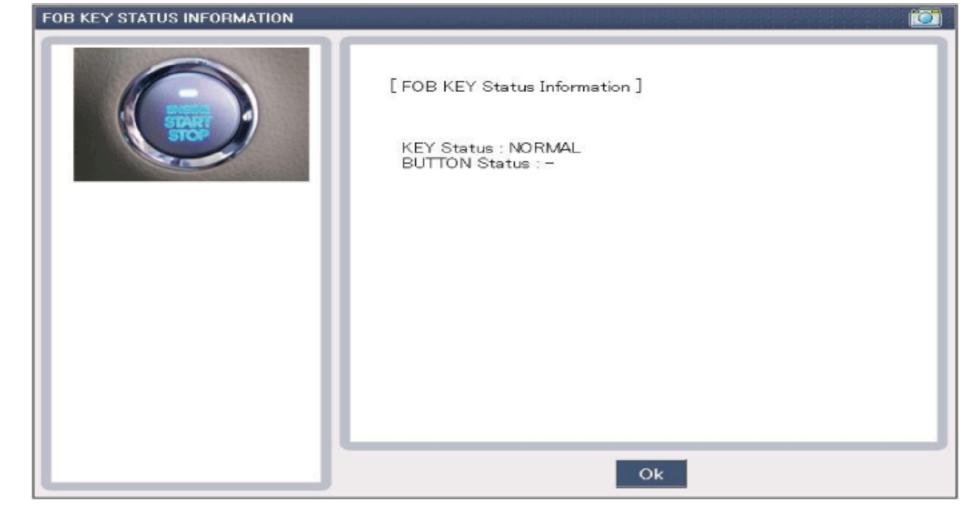
5. If the LED of smart key is not blinking, check the antenna in shade area.



### **FOB Status Check**

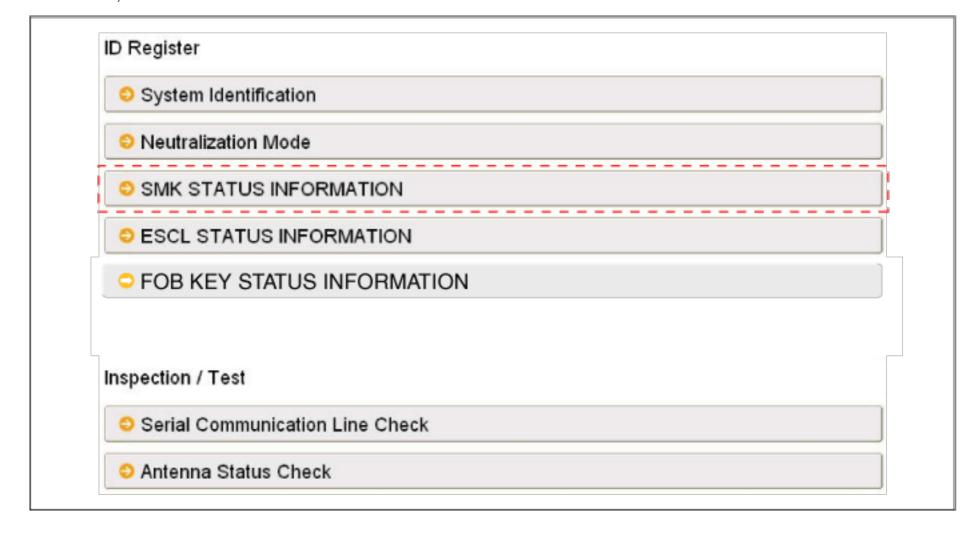
- 1. Connect the cable of GDS to the data link connector in driver side crash pad lower panel.
- 2. After IGN ON, select the "FOB KEY STATUS INFO".

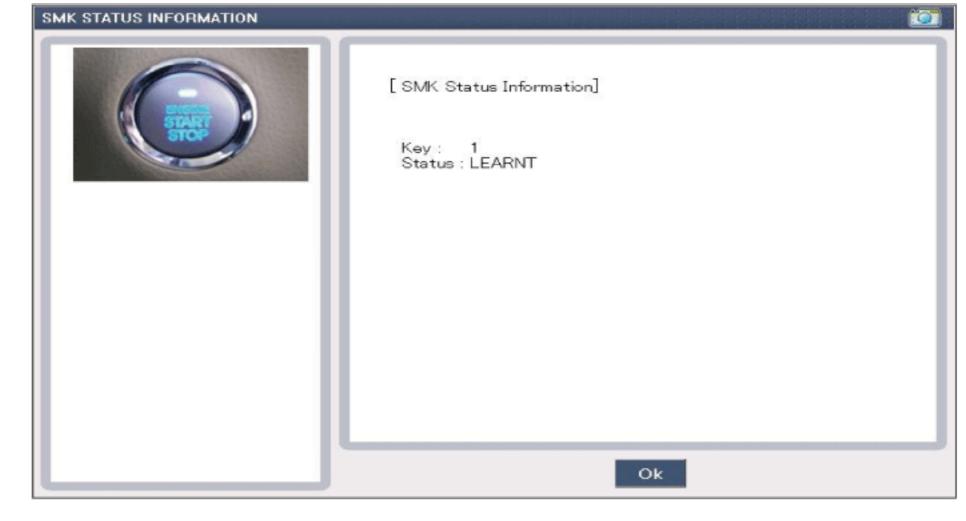




# **Smart Key Status Check**

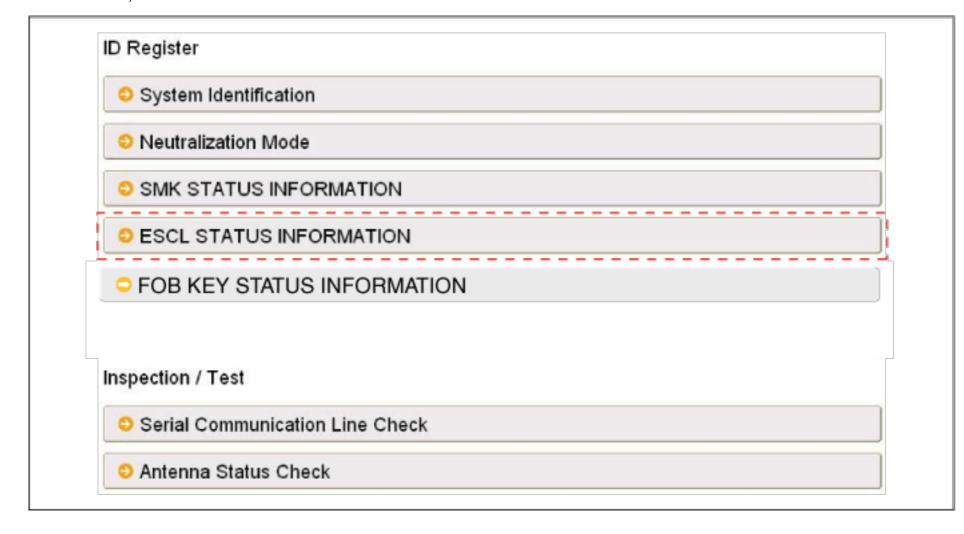
- 1. Connect the cable of GDS to the data link connector in driver side crash pad lower panel.
- 2. After IG ON, select the "SMK STATUS INFO".

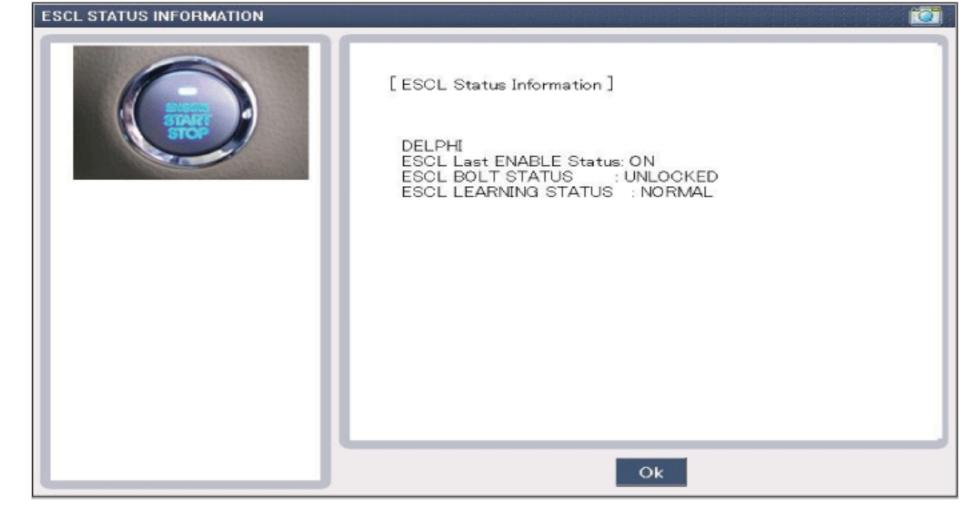




### **ESCL Status Check**

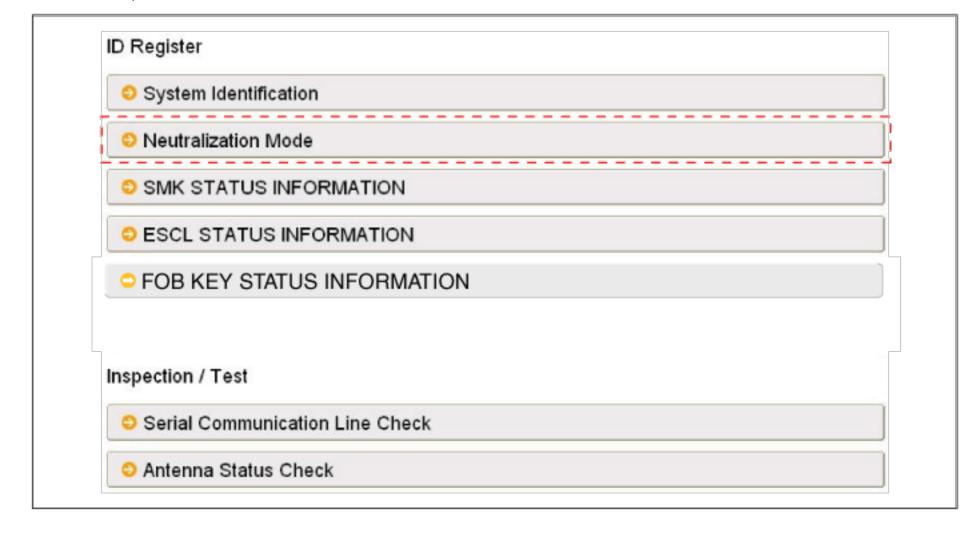
- 1. Connect the cable of GDS to the data link connector in driver side crash pad lower panel.
- 2. After IGN ON, select the "ESCL STATUS INFO".

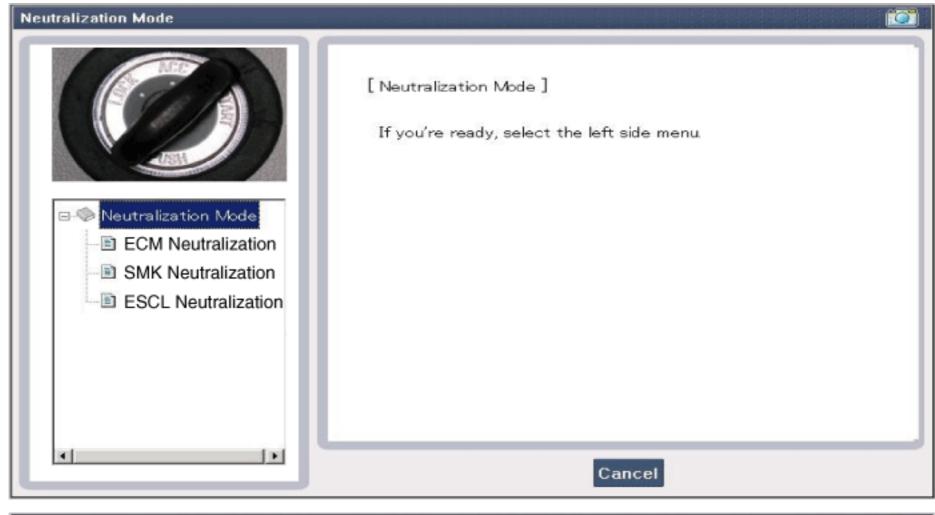


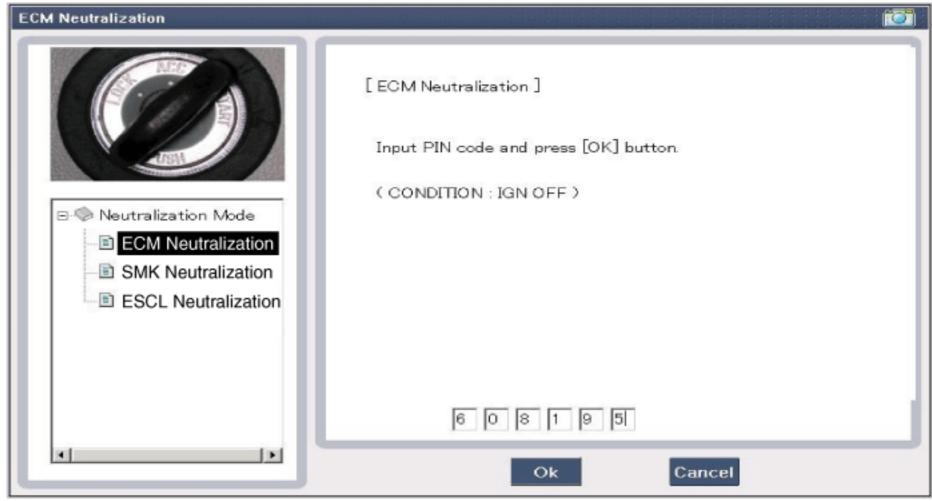


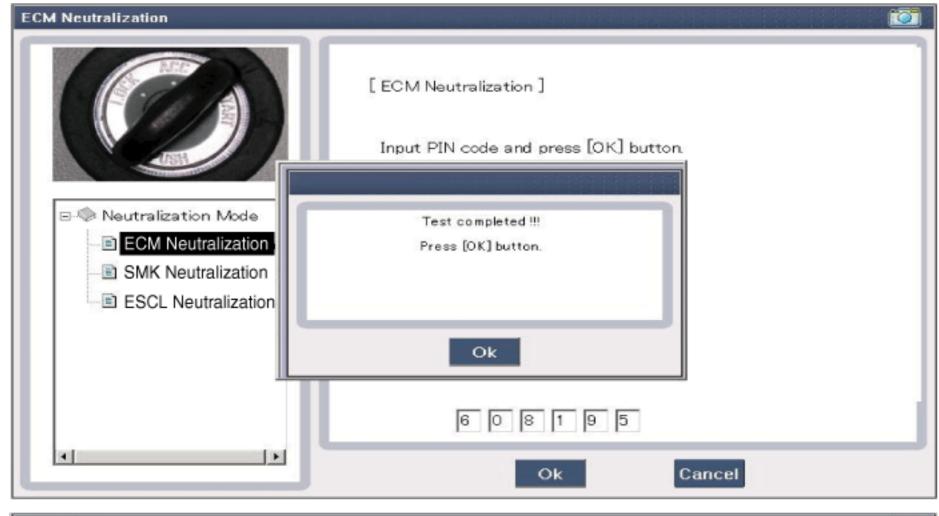
#### **Neutralization Status Check**

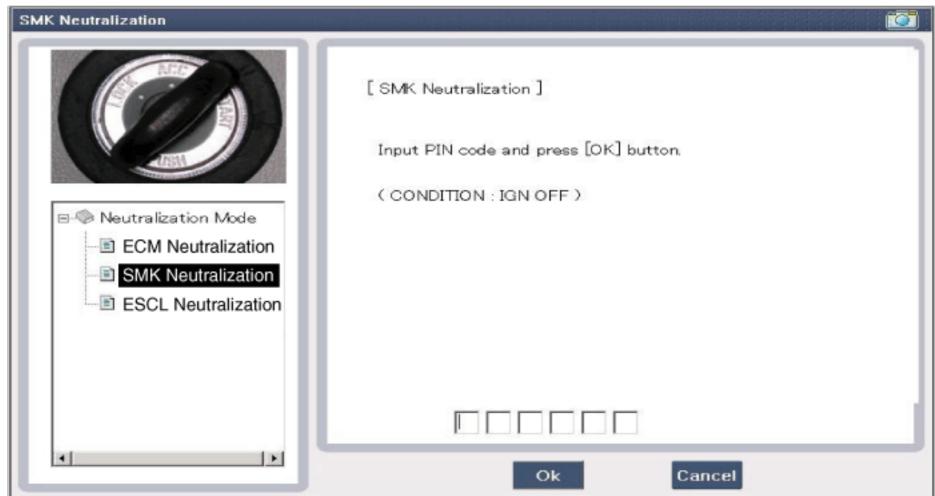
- 1. Connect the cable of GDS to the data link connector in driver side crash pad lower panel.
- 2. After IGN ON, select the "Neutralization mode".

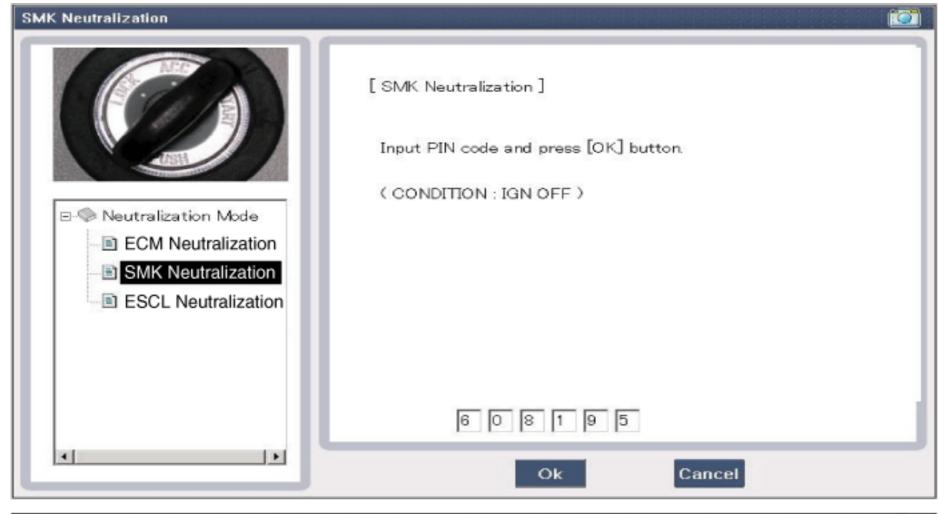


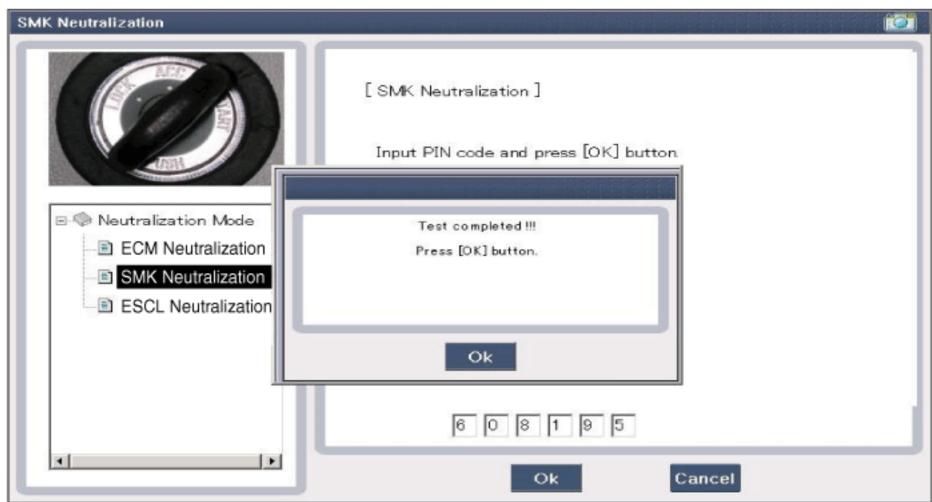


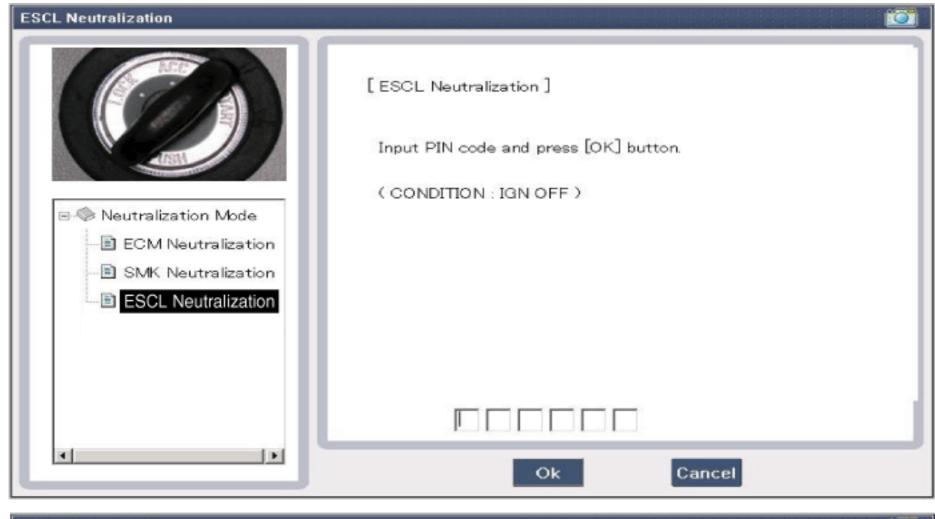


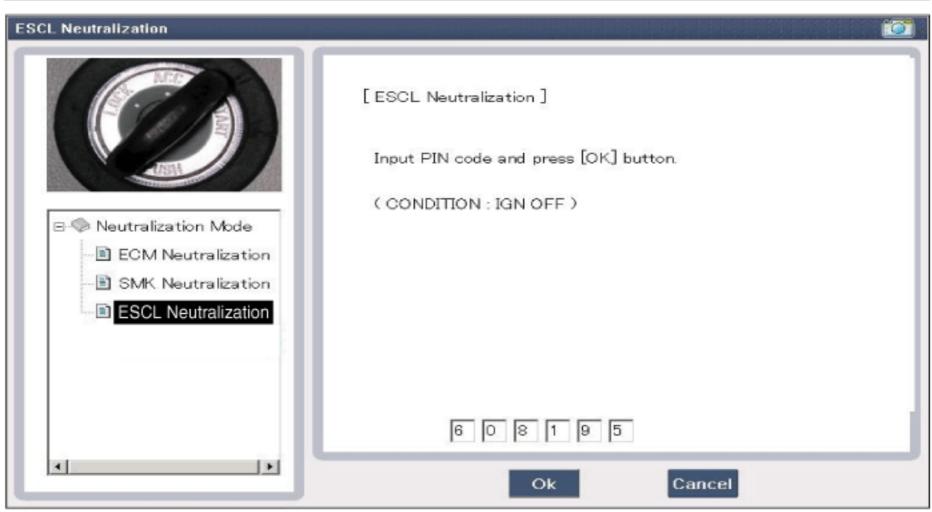














# **Input Switch List**

1	SSB switch2	-
2	ACC	-
3	IGN1	-
4	Gear 'P' Position	-
5	Brake switch	-
6	FL Door Lock Button	-
7	FR Door Lock Button	-
8	Trunk Lid switch	-
9	Battery Voltage	-
10	Alternator Voltage	-
11	KEY out Indicator Lamp	-
12	Immobilizer Lamp	-
13	External Buzzer	-
14	ESCL Enable	-

Item name

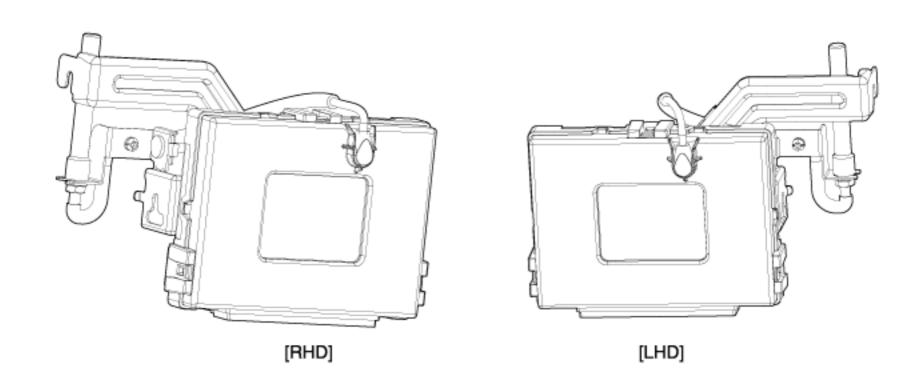
Unit

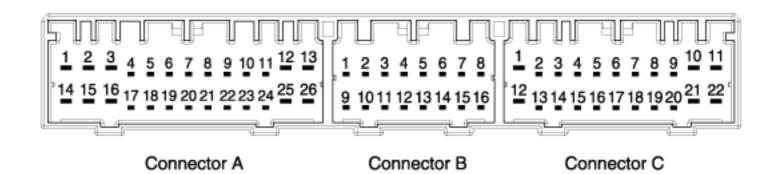
### **Actuator List**

No.	Item name	Condition
1	Immo.indicator Lamp	Ignition switch ON Engine off
2	External Buzzer	Ignition switch ON Engine off
3	Interior Antenna 1 Active	Ignition switch ON Engine off
		Ignition switch ON

4	Interior Antenna 2 Active	Engine off
5	Trunk Antenna Active	Ignition switch ON Engine off
6	Bumper Antenna Active	Ignition switch ON Engine off
7	DRV DR Antenna Active	Ignition switch ON Engine off
8	AST DR Antenna Active	Ignition switch ON Engine off

# **COMPONENTS (1)**





### **Connector Pin Information**

12

**B\_CAN** High

No.	Connector A	Connector B	Connector C	
1	V_BAT load	C_CAN Low	SSB illumination ground	
2	ESCL ground	C_CAN High	Immobilizer indicator	
3	Power ground1	-	-	
4	IGN1	Stop lamp fuse	Interior antenna #2 power	
5	IGN1 relay	Brake switch	Interior antenna #1 power	
6	ACC	Immobilizer antenna power	-	
7	IGN2	ESCL enable	-	
8	SSB switch2	Wheel speed	-	
9	-	Driver toggle button	Bumper antenna power	
10	-	ESCL unlock	Passenger side antenna power	
11	ESCL COM	External buzzer	Driver side antenna power	
	I		·	

P position/ Clutch switch

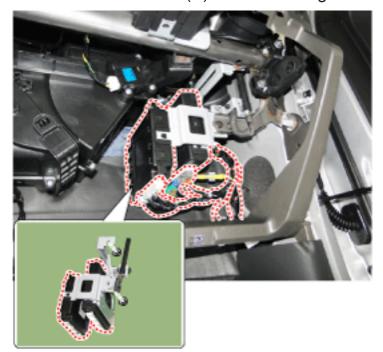
SSB LED IGN

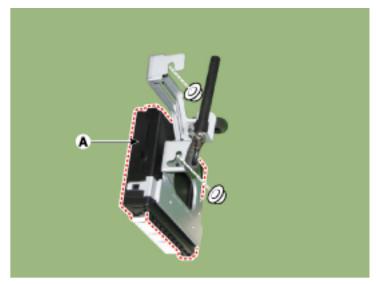
13	B_CAN Low	Start feedback	SSB illumination power
14	V_BAT CPU	Immobilizer antenna ground	-
15	ESCL battery	-	Interior antenna #2 ground
16	Power ground2	SSB LED ACC	Interior antenna #1 ground
17	Starter relay		-
18	IGN2 relay		-
19	ACC relay		-
20	-		Bumper antenna ground
21	-		Passenger side antenna ground
22	-		Driver side antenna ground
23	RPM		
24	EMS COM		
25	SSB switch1		
26	Assistant toggle button		

#### **REMOVAL**

### Smart Key Unit

- 1. Disconnect the negative (-) battery terminal.
- Remove the glove box housing. (Refer to Body - "Glove box housing")
- 3. Remove the SMK unit (A) after loosening nuts.



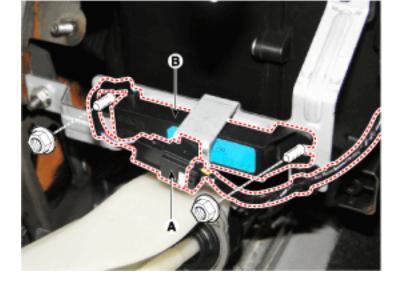


### Interior 1 Antenna

#### NOTICE

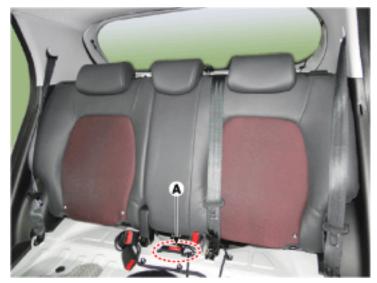
Take care not to scratch the crash pad and related parts.

- 1. Disconnect the negative (-) battery terminal.
- Remove the crash pad center lower tray assembly. (Refer to Body - "Main Crash Pad Assembly")
- 3. Remove the interior 1 antenna (B) after loosening the mounting nuts (2EA) and disconnecting the connector (A).



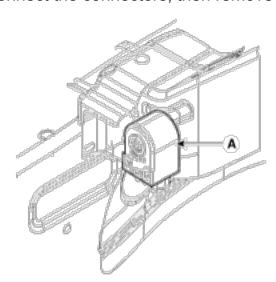
### Interior 2 Antenna

- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the rear seat cushion. (Refer to Body "Rear Seat")
- 3. Remove the interior 2 antenna (A) after loosening the mounting nuts (2EA) and disconnecting the connector.



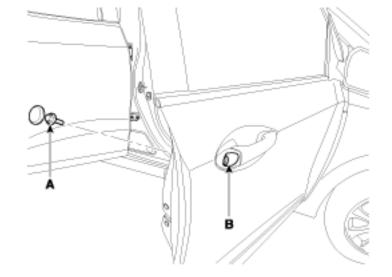
### Buzzer

- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the front left wheel guide.
- 3. Disconnect the connectors, then remove the buzzer (A).

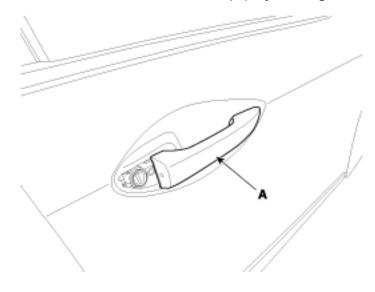


#### **Door Outside Handle**

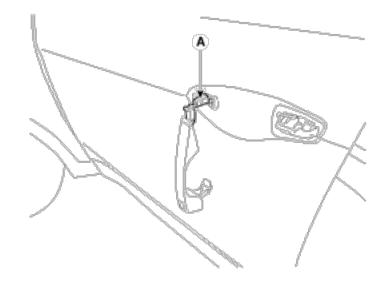
- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the door outside handle cover (A) after seperating the plug hole (B) from the door and loosening the mounting bolt.



3. Remove the outside handle (A) by sliding it rearward.



4. Disconnect the door outside handle connector (A).



### **INSPECTION**

## **Smart Key Unit**

(Refer to Smart Key System - "Smart Key Diagnostic")

## **Smart Key Switch**

(Refer to Smart Key System - "Smart Key Diagnostic")

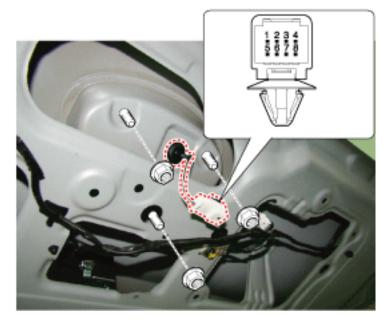
#### Antenna

(Refer to Smart Key System - "Smart Key Diagnostic")

## Tailgate Open Switch

Remove the tailgate trim.
 (Refer to Body - "Tailgate Trim")

2. Disconnect the connector from Tailgate open switch.



3. Check for continuity between the terminals in each switch position according to the table.

Terminal Position	1	2
OFF		
ON	0	

#### **INSTALLATION**

### Smart Key Unit

- 1. Install the smart key unit.
- 2. Install the smart key unit mounting bolts and connect the connector.
- 3. Install the glove box housing.
- 4. Install the negative (-) battery terminal and check the smart key system.

### Interior 1 Antenna

- 1. Install the interior 1 antenna.
- 2. Install the crash pad center lower tray assembly.
- 3. Install the negative (-) battery terminal and check the smart key system.

#### Interior 2 Antenna

- 1. Install the interior 2 antenna.
- 2. Install the rear seat cushion.
- 3. Install the negative (-) battery terminal and check the smart key system.

#### Buzzer

- 1. Install the buzzer.
- 2. Install the front left wheel guide.
- 3. Install the negative (-) battery terminal and check the smart key system.

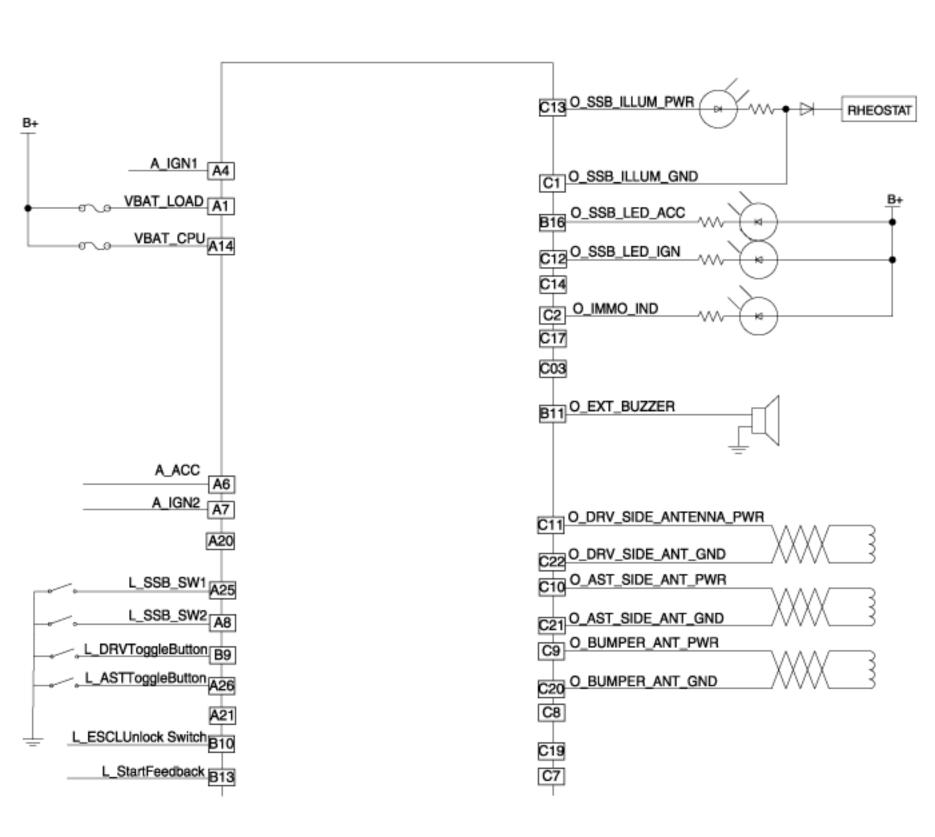
#### **Door Outside Handle**

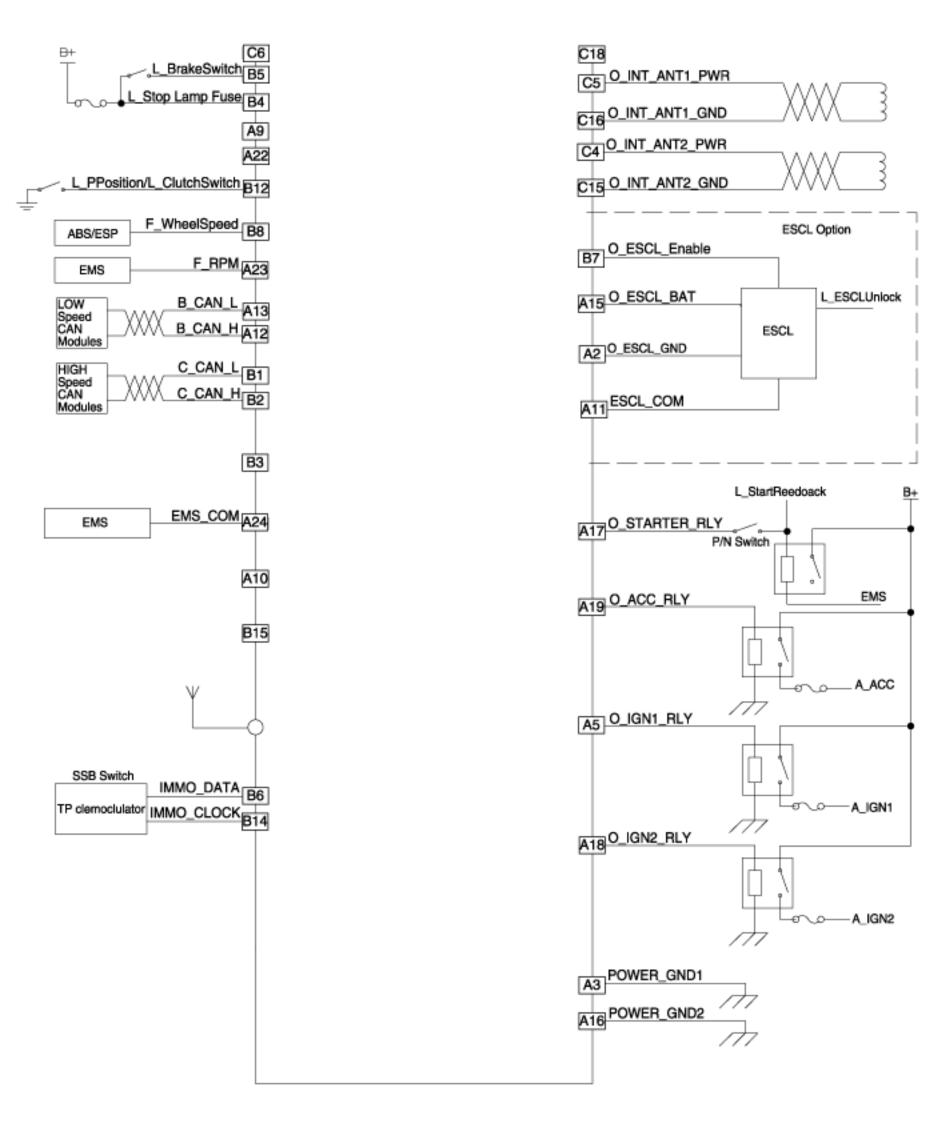
- 1. Install the outside handle.
- 2. Install the door trim.
- 3. Install the negative (-) battery terminal and check the smart key system.

# Tailgate Switch

- 1. Install the tailgate switch.
- 2. Install the tailgate garnish.
- 3. Install the tailgate trim.
- 4. Install the negative (-) battery terminal and check the smart key system.

#### **CIRCUIT DIAGRAM**





# **SPECIFICATIONS**

# Smart Key Unit

Items	Specification
Rated voltage	DC 12V
Operating voltage	DC 9 ~ 16V
Operating temperature	-22°F ~ 167°F (-30°C ~ 75°C)
Load	Max. 2.9mA (When welcome light function off)

## RF Receiver

Items	Specification
Frequency	433.92 Mhz
Antenna type	FSK (Frequency Shift Keying)

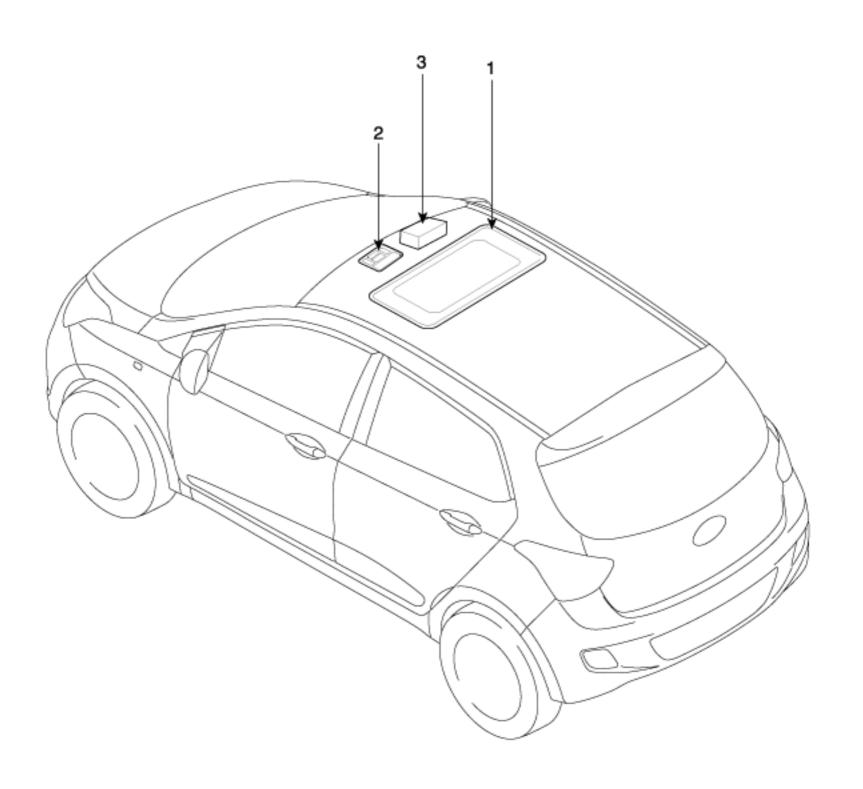
# Smart Key Fob

Items	Specification	
Battery	Lithium battery 3V 1EA	
Distance	30m from vehicle, RF : 30m, Passive(LF) : 0.7m	
	More than 2 years (10 times / a day)	
Battery life	An inappropriately disposed battery can be harmful to the environment and human health.  Dispose the battery according to your local law(s) or regulation.	
Push buttons	3 (Door lock / unlock, Tailgate)	
Frequency(Rx)	125 kHz	
Frequency(Tx)	315 MHz	
Numbers	2EA	

## Antenna

Items	Specification	
Rated voltage	DC 12V	
Operating voltage	DC 9 ~ 16V	
Operating temperature	-22°F ~ 167°F (-30°C ~ 75°C)	
Frequency	125kHz	
Numbers	Interior(2EA), Door(2EA), Bumper(1EA)	

# **COMPONENT LOCATION**

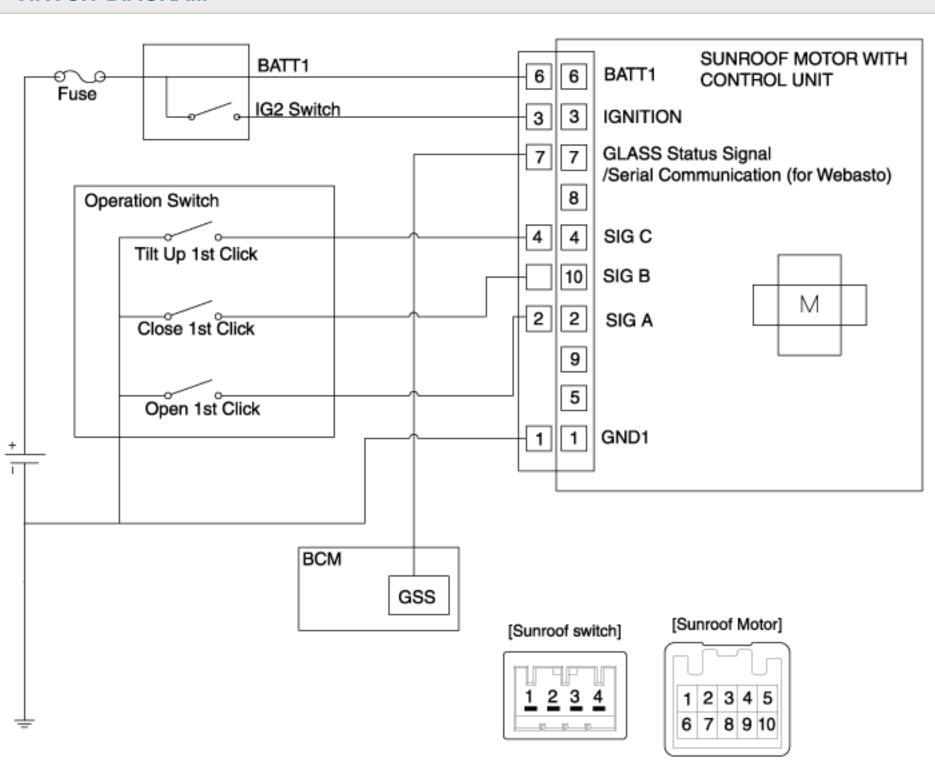


1	Sı	J٢	nr	0	of	

2. Sunroof switch

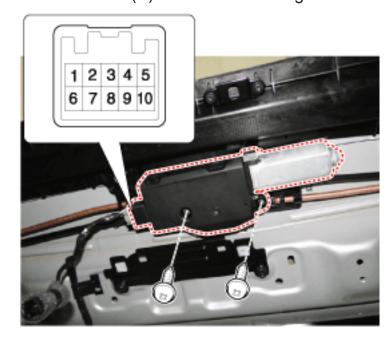
3. Sunroof motor & controller

#### **CIRCUIT DIAGRAM**



#### **REPLACEMENT**

- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the overhead console then remove the sun roof motor mounting screws (3EA). And then remove the sunroof motor (A) after disconnecting the connector (10 Pin).



3. Ground the terminals as below table, and check that the sunroof unit operates as below table.

Terminal	3	4	5	10
Manual Open	$\oplus$		$\ominus$	
Auto Open	$\oplus$		$\oplus$	$\odot$
Manual Close, Manual Tilt Down	$\oplus$			$\oplus$
Auto Close	$\oplus$	$\oplus$		$\oplus$
Manual Tilt Up	$\oplus$	$\ominus$		

Make these input tests at the connector
if any test indicates a problem, find and correct the cause, then recheck the system.
If all the input tests prove OK, the sunroof motor must be faulty; replace it.

Terminal	Test condition	Test : Desired result
3	3 IG2 ON Check for voltage to ground : There should be battery voltage	
1 Inder all conditions		Check for continuity to ground : There should be continuity.
l Inder all conditions		Check for voltage to ground : There should be battery voltage.

## Resetting The Sunroof

Whenever the vehicle battery is disconnected or discharged, or you use the emergency handle to operate the sunroof, you have to reset your sunroof system as follows :

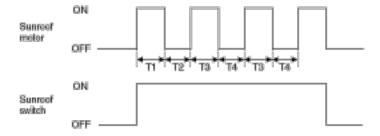
- 1. Turn the ignition key to the ON position.
- 2. According to the position of the sunroof, do as follows.

- (1) In case that the sunroof has closed completely or been tilted : Press the TILT button until the sunroof has tilted upward completely.
- (2) In case that the sunroof has slide-opened : Press and hold the CLOSE button for more than 5 seconds until the sunroof has closed completely. Press the TILT button until the sunroof has tilted upward completely.
- 3. Release the TILT button.
- 4. Press and hold the TILT button once again until the sunroof has returned to the original position of TILT after it is raised a little higher than the maximum TILT position.
  When this is complete, the sunroof system is reset.

### Protecting The Overheated Motor

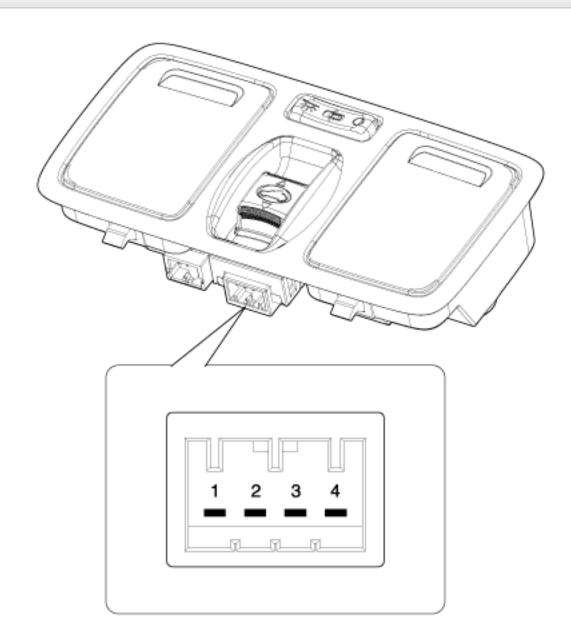
In order to protect the overheated sunroof motor by continuous motor operation, the sunroof ECU controls the Run-time and Cool-time of motor as followings;

- 1. The Sunroof ECU detects the Run-time of motor
- 2. Motor can be operated continuously for the 1st Run-time( $120 \pm 10$ sec.).
- 3. Motor which is operated continuously stops operating after the 1st Run-time(120  $\pm$  10sec.).
- 4. And then Motor is not operated for the 1st Cool-time(18  $\pm$  2sec.).
- 5. Motor is operated for the 2nd Run-time(10  $\pm$  2sec.) at the continued motor operation after 1st Cool-time(18  $\pm$  2sec.)
- 6. Motor which is operated continuously stops operating after the 2nd Run-time(10 ± 2sec.)
- 7. Motor is not operated for the 2nd Cool-time( $18 \pm 2$ sec.).
- 8. Motor repeats the 2nd Run-time and 2nd Cool-time at the continued motor operation.
  - In case that motor is not operated continuously, the Run-time which is limited for protecting the overheated motor is increased.
  - The Run-Time of motor is initialized to "0" if the battery or fuse is reconnected after being disconnected, discharged or blown.

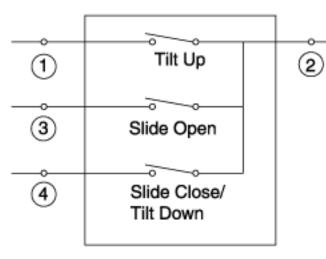


T1:  $120 \pm 10$  sec., T2:  $18 \pm 2$  sec., T3:  $10 \pm 2$  sec., T4:  $18 \pm 2$  sec.

# **COMPONENTS**



Earth



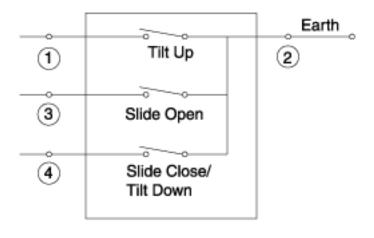
NO	Pin	Switch Logic			
NO	Function	Open	Tilt - Up	Close/Down	
1	Tilt up	OFF	ON	OFF	
2	Earth	ON	ON	ON	
3	Slide Open	ON	OFF	OFF	
4	Close/Down	OFF	OFF	ON	

## **INSPECTION**

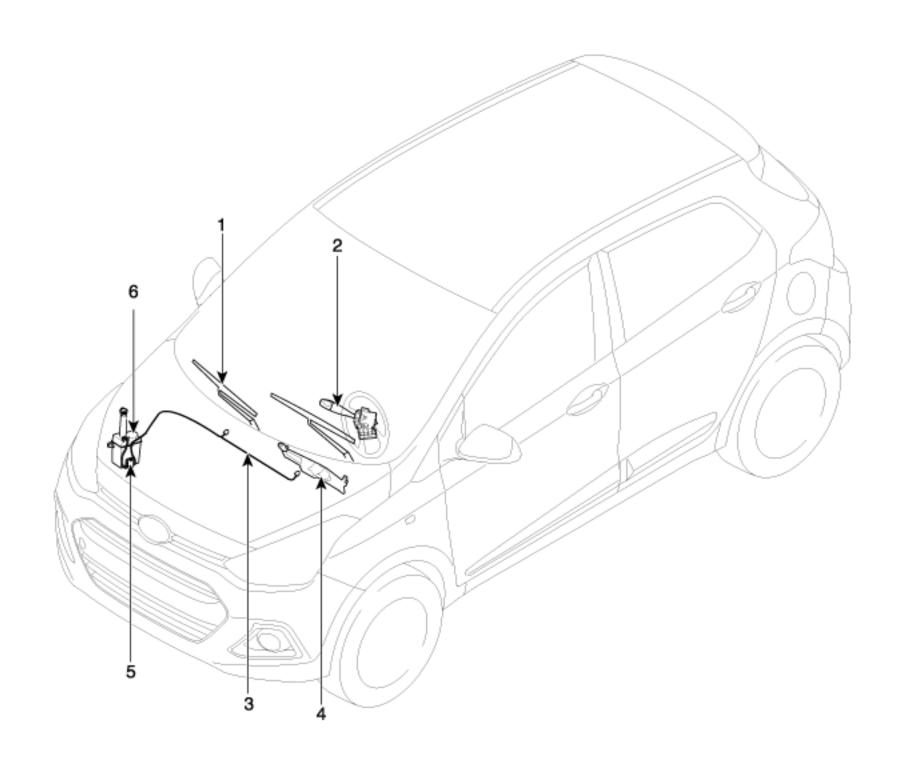
- 1. Disconnect the negative (-) battery terminal.
- Remove the sunroof switch.
   (Refer to Lighting System "Overhead Console Lamp")
- 3. Check for continuity between the terminals. If the continuity is not as specified, replace the sunroof switch.



Terminal Position	1	2	3	4
Slide Open		$\overline{\circ}$	_	
Tilt Up	$\overline{\bigcirc}$	_		
Tilt Down		<u></u>		_
Slide Close		$\overline{\bigcirc}$		_



## **COMPONENT LOCATION**



- 1. Windshield wiper arm & blade
- 2. Wiper & washer switch
- 3. Windshield washer hose
- 4. Windshield wiper motor & linkage

- 5. Washer motor
- 6. Washer reservoir

#### **INSPECTION**

#### Front and Rear Washer Motor

1. With the washer motor connected to the reservoir tank, fill the reservoir tank with water.

### NOTICE

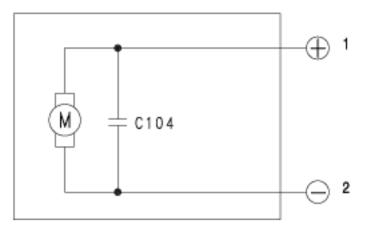
Before filling the reservoir tank with water, check the filter for foreign material or contamination. if necessary, clean the filter.

- 2. Connect positive (+) battery cables to terminal 1 and negative (-) battery cables to terminal 2 respectively.
- 3. Check that the motor operates normally and the washer motor runs and water sprays from the front nozzles.
- 4. If they are abnormal, replace the washer motor.

### [Front & Rear washer]

No.	Description			
2	Ground			
1	Windshield washer (+)			



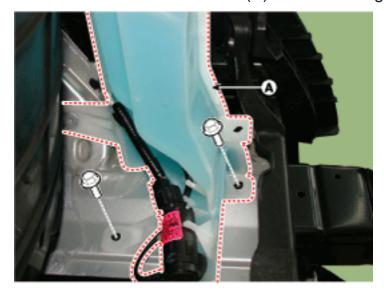


## **▲** CAUTION

- When servicing the washer pump, be careful not to damage the washer pump seal.
- Do not operate the washer pump before filling the washer reservoir.
   Failure to do so could result in premature pump failure.
- 1. Disconnect the negative (-) battery terminal.
- Remove the front bumper lower cover. (Refer to Body - "Front Bumper Cover")
- 3. Remove the washer hose and disconnect the washer motor connector (A).



4. Remove the washer reservoir (A) after removing bolts.



#### **INSTALLATION**

1. Reassemble the washer reservoir.

#### NOTICE

Before installing the pump motor, check the filter for foreign material or contamination. if necessary, clean the filter into the pump motor.

- 2. Connect the washer motor connector and washer hose.
- 3. Reassemble the front bumper lower cover.

### **REMOVAL**

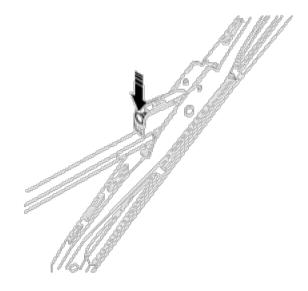
1. Remove the cap (B) and remove the nuts, then remove the wiper arm (A).

#### Tightening torque:

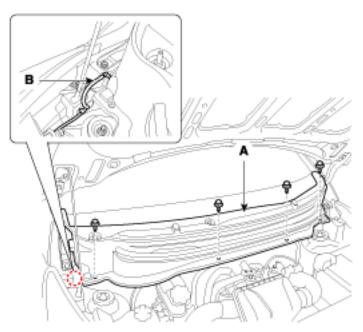
22.6 ~ 26.5 N.m (2.3 ~ 2.7 kgf.m, 16.6 ~ 19.5 lb-ft)



2. If necessary, release the wiper blade fixing clip by pulling up and remove the wiper blade from the inside radius of wiper arm.



3. Remove the weather strip and the cowl top cover (A) after removing 4 rivets.



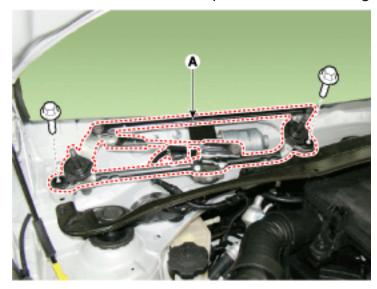
- 4. Disconnect the washer hose (B) connected to cowl top cover.
- 5. Disconnect the wiper motor connector (A) from the wiper motor & linkage assembly.



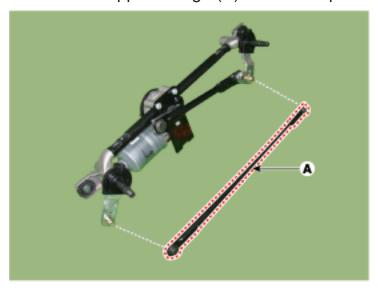
# **▲** CAUTION

Before removing the wiper motor and linkage assembly, make sure that the linkage is stopped at auto stop position.

6. Remove the windshield wiper motor and linkage assembly (A) after removing 2 bolts.



7. Remove the upper linkage (A) from the wiper motor arm assembly.



# **▲** CAUTION

Before removing the wiper motor and linkage assembly, make sure that the linkage is stoped at auto stop position.



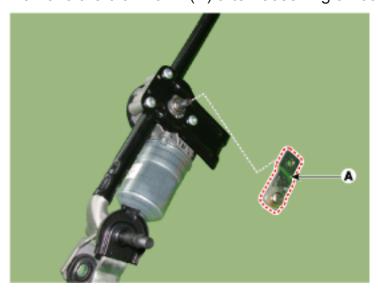
To install the wiper motor crank arm exactly, check that the linkage is aligned with the crank arm in straight line and the angle of each linkages.

Be careful not to bend the linkage.

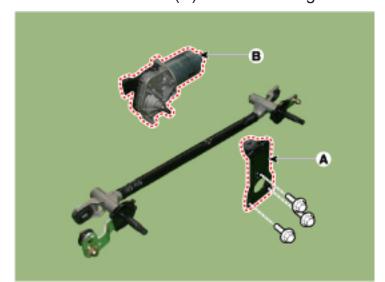
8. Hold the wiper motor crank arm and remove the upper linkage (A) from the wiper motor crank arm.



9. Remove the crank arm (B) after loosening a nut (A).



10. Remove the bracket (A) after loosening the screws from the wiper motor (B).



#### **INSTALLATION**

- 1. Install the wiper motor.
- 2. Install the wiper motor on wiper linkage assembly with 3 bolts.



#### **Tightening torque:**

6.4 ~ 6.6 N.m (0.65 ~ 0.67 kgf.m, 4.7 ~ 4.8 lbf-ft)

### **▲** CAUTION

Do not apply more then tightening torque because there should be tube hole shape deformation. After shape deformation, it is not possible to guarantee normal operation anymore.

Install the wiper motor assembly to the vehicle body.

#### **Tightening torque:**

6.9 ~ 10.8 N.m (0.70 ~ 1.10 kgf.m, 5.09 ~ 7.96 lb-ft)

- 4. Before install the wiper linkage arms ball socket on the motor crank arm, connect the motor power connector.
- 5. Turn on switch to activate wiper motor and turn OFF in the middle.
- 6. Put the ball socket and clip the wiper linkage arm rodsocket on the motor crank ball.
- 7. Turn ON the power with the car key and put the switch to turn off the wipers in normal operation. (Auto- Parking position)
- 8. Install cowl top cover.
- 9. Install the windshield wiper arm and blade.

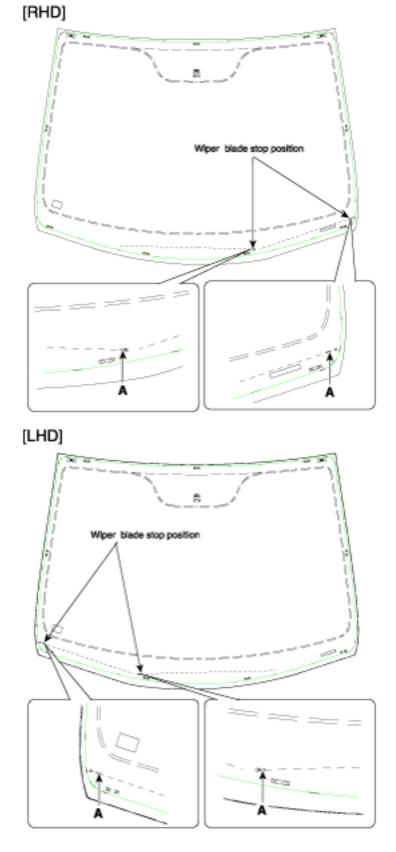
#### Tightening torque:

22.6 ~ 26.5 N.m (2.3 ~ 2.7 kgf.m, 16.6 ~ 19.5 lb-ft)

#### NOTICE

- The windshield wiper motor must be cycled to make sure that it is in the auto stop position.
   If necessary, adjust the wiper arm and blade.
- 10. Install the wiper arm and blade to the auto stop position.

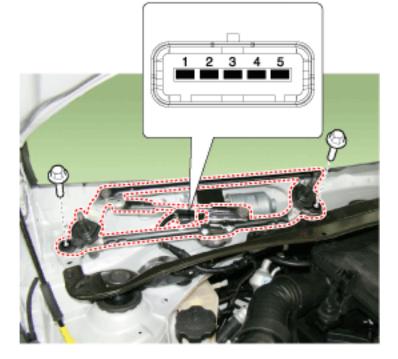
A: Auto stop position (Blade)



## **INSPECTION**

# **Speed Operation Check**

1. Operate the wiper switch to check for continuity between wiper motor terminals.

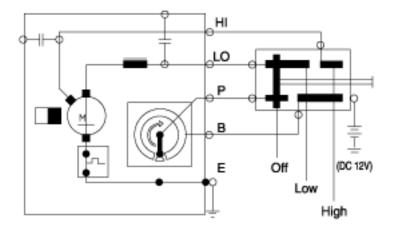


# RHD(LHD)

No.	Description	No.	Description
4(2)	Low	5(1)	High
1(5)	GND	2(4)	Parking
3(3)	Battery	-	-

2. Connect the connector and check that the motor operates at low or high speed as below table.

Terminal Position	4(2)	5(1)	2(4)	3(3)
Off	0			
Low	0—			_
High		0—		



3. Check the wiping quality.

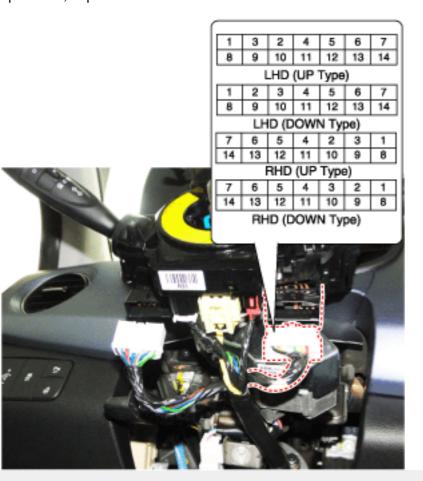
# **▲** CAUTION

Common sources of contamination are insects, tree sap, and hot wax treatments used by some commercial car washes. If the blades are not wiping properly, clean both the window and the blades with a good cleaner or mild detergent, and rinse thoroughly with clean water.

#### **INSPECTION**

### Wiper And Washer Switch Inspection

With the multifunction switch in each position, make sure that continuity exists between the terminals below. If continuity is not as specified, replace the multi-function switch.



#### **Wiper Switch**

Terminal Position	3	2	4	5	INT1	INT2	B1
MIST	$\Diamond$		0				
OFF			0-	-0	0		0
INT			0-	-	0-	-0	
LOW	9		0				
Н	0	-0					

#### **Washer Switch**

Terminal Position	3	6
OFF		
ON	0	

#### **Rear Wiper Switch**

Terminal Position	13	11	14
OFF	0		
ON	0		

#### **Rear Washer Switch**

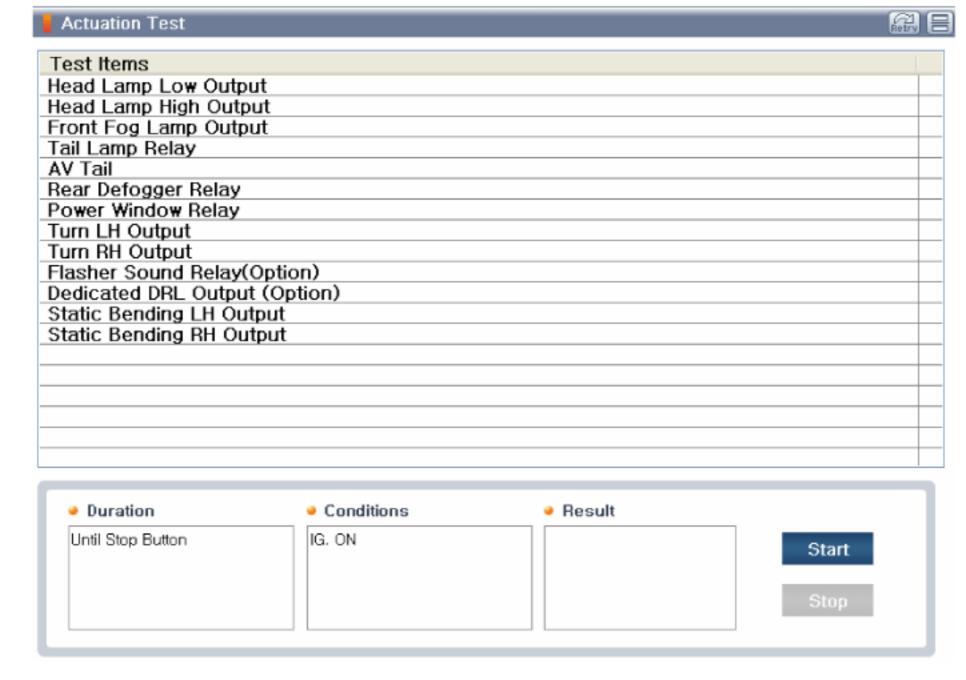
Terminal Position	13	14	12
OFF			
ON	0-	<u> </u>	<u> </u>

### **INSPECTION (WITH GDS)**

- 1. Check BCM input/output specification of multifunction switch using the GDS. If the specification is abnormal, replace the lamp or wiper switch.
- 2. If diagnosis is required on the multifunction switch, select model and "BCM".
- 3. To consult the present input/output value of BCM, "Current DATA". It provides information of BCM input/output conditions of power supply, turn signal/brake lamp, headlamp, door, locks, outside mirror, wiper, auto-light and transmitters etc.



4. To perform compulsory operation on BCM input factors, select "ACTUATION TEST".



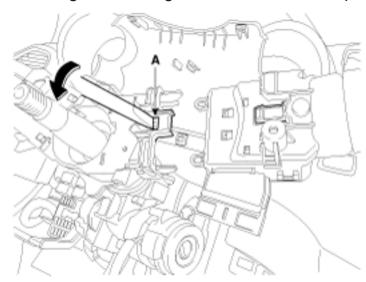
#### **REMOVAL**

- 1. Disconnect the negative (-) battery terminal.
- Remove the steering wheel. (Refer to Steering System - "Steering Wheel")
- 3. Remove the steering column shroud lower/upper panel. (Refer to Body "Steering Column Shroud Panel")
- Remove the clock sping.
   (Refe to Restraint "Driver Airbag (DAB) and Clock Spring")
- 5. Disconnect the lighting switch connector (A) and wiper & washer switch connector (B).

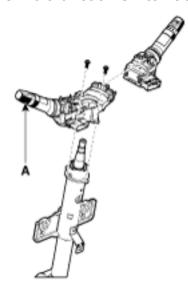


6. If it is necessary to remove. The wiper & washer switch (A) only, release the lock of wiper switch using tool without

removing the steering wheel and the clock spring.



7. Remove the multifunction switch assembly (A) after loosening 2 screws.



## **INSTALLATION**

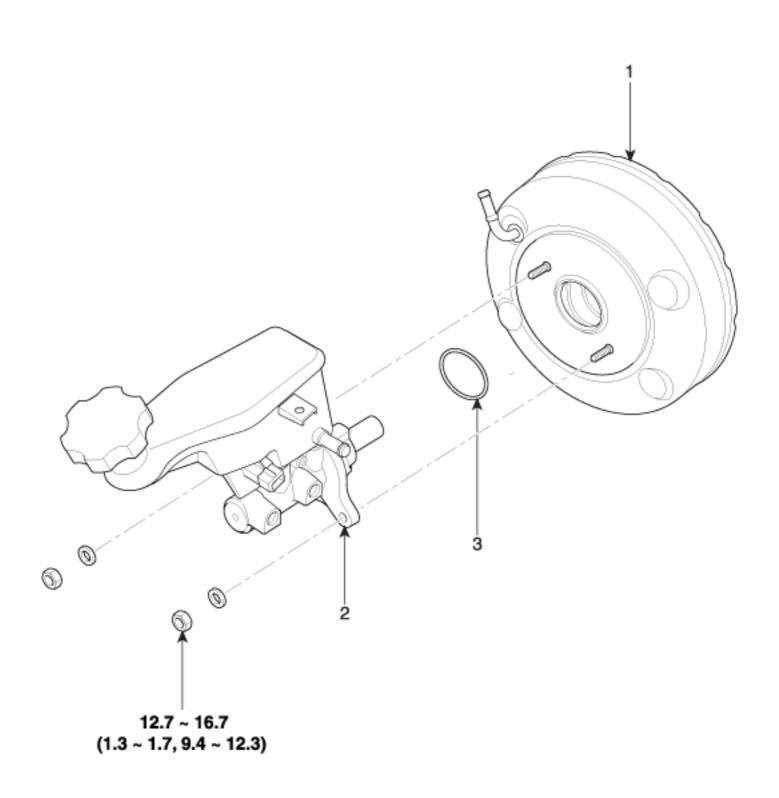
- 1. Install the multifunction switch.
- 2. Install the clock spring.
- 3. Install the steering column upper and lower shrouds.
- 4. Install the steering wheel.

## NOTICE

Make sure the multifunction switch connectors are plugged in properly.

## **COMPONENTS**

[LHD]

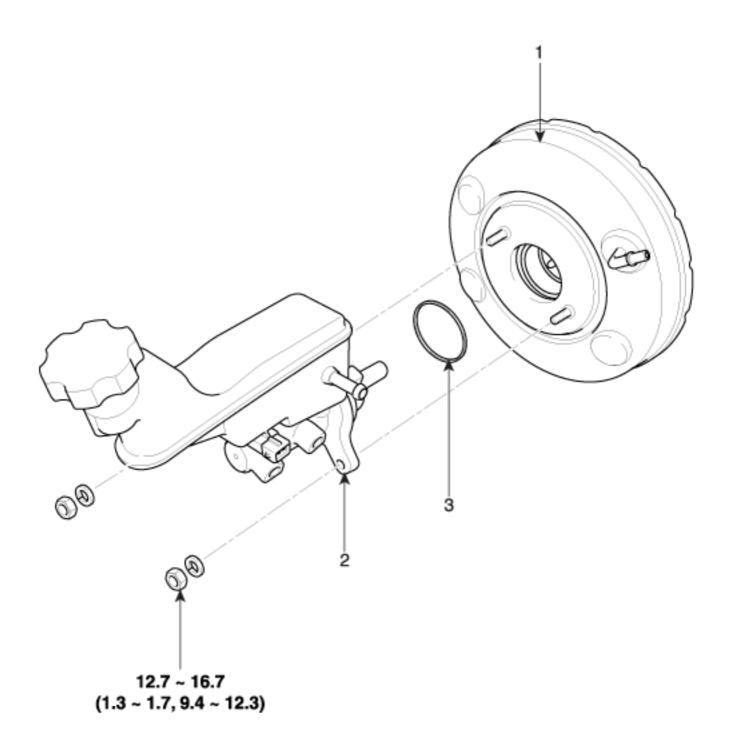


### Torque: N.m (kgf.m, lb-ft)

1	R	ra	ke	R	$\cap$	76	t۵	r
-	 ப	ıa	r	ப	w	JO	ᄕ	ı

2. Master cylinder assembly

3. O-ring



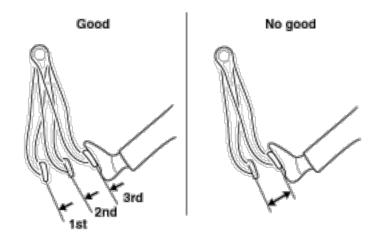
# Torque : N.m (kgf.m, lb-ft)

1. Brake Booster	3. Vaccum Hose
2. Master cylinder	

#### **BRAKE BOOSTER OPERATING TEST**

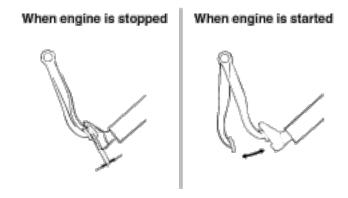
For simple checking of the brake booster operation, carry out the following tests.

1. Run the engine for one or two minutes, and then stop it. If the pedal depresses fully the first time but gradually becomes higher when depressed succeeding times, the booster is operating properly, if the pedal height remains unchanged, the booster is inoperative.

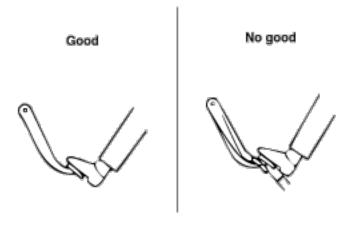


2. With the engine stopped, step on the brake pedal several times.

Then step on the brake pedal and start the engine. If the pedal moves downward slightly, the booster is in good condition. If there is no change, the booster is inoperative.



3. With the engine running, step on the brake pedal and then stop the engine. Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition, if the pedal rises, the booster is inoperative. If the above three tests are okay, the booster performance can be determined as good. Even if one of the above three tests is not okay, check the check valve, vacuum hose and booster for malfunction.



#### **REMOVAL**

- 1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
- 2. Remove the battery (A) and ECM (B). [LHD]



- 3. Remove the air cleaner assembly. [RHD]
  (Refer to Engine and Transaxle Assembly "Air Cleaner")
- 4. Remove the brake fluid from the master cylinder reservoir.

## NOTICE

Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.

5. Disconnect the vacuum hose (A) from the brake booster.

#### [LHD]



[RHD]



6. Disconnect the brake fluid level switch connector (A).

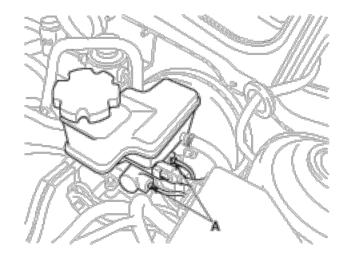
### [LHD]



[RHD]



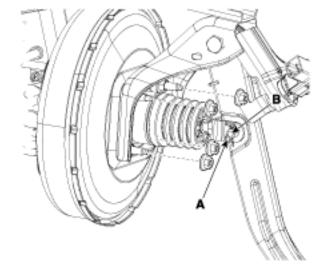
- 7. Remove the brake fluid from the master cylinder reservoir.
- Remove the master cylinder. (Refer to Brake System - "Master Cylinder")



- 9. Remove the clevis pin (A) and snap pin (B).
- 10. Remove the mounting nuts.

### Tightening torque:

16.7 ~ 25.5 N.m (1.7 ~ 2.6 kgf.m, 12.3 ~ 18.8 lb-ft)



11. Remove the brake booster.

#### **INSPECTION**

1. Inspect the check valve in the vacuum hose.



Do not remove the check valve from the vacuum hose.

2. Check the boot for damage.

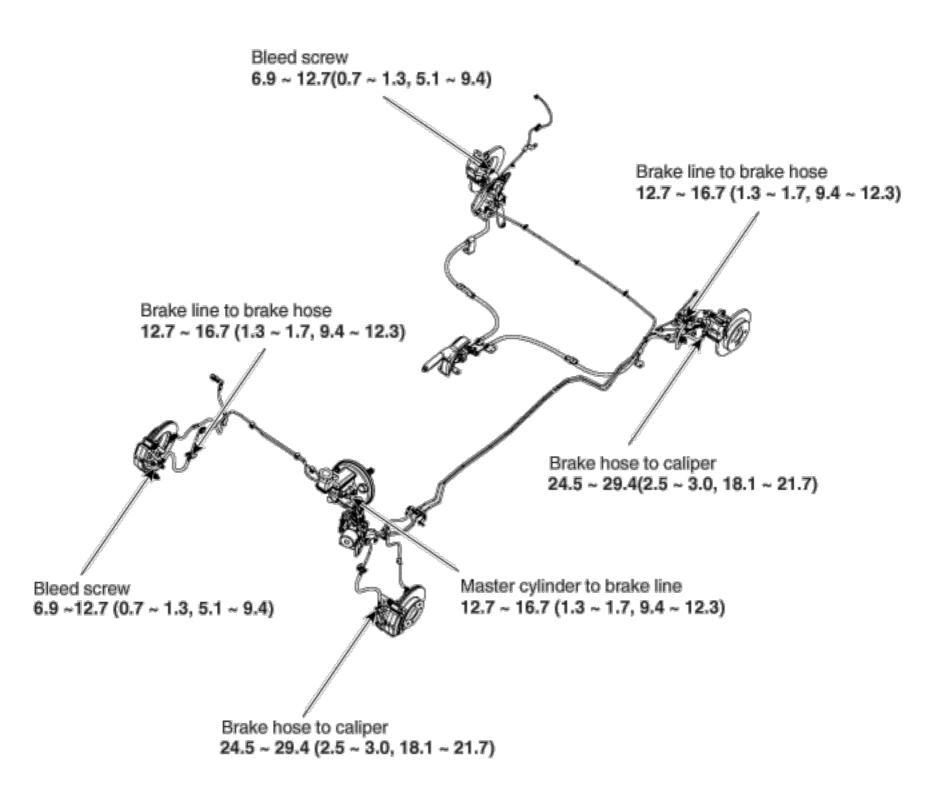
#### **INSTALLATION**

1. Installation is the reverse of removal.

#### NOTICE

- Before installing the pin, apply the grease to the joint pin.
- Use a new snap pin whenever installing.
- After installing, bleed the brake system.
   (Refer to Brake System "Brake System Bleeding")
- 3. Check and adjust the brake pedal for proper operation. (Refer to Brake System "Brake Pedal")

#### **COMPONENTS**



Torque: N.m (kgf.m, lb-ft)

#### **REMOVAL**

- 1. Disconnect the brake fiuid level switch connector, and remove the reservoir cap.
- 2. Remove the brake fluid from the master cylinder reservior.

### NOTICE

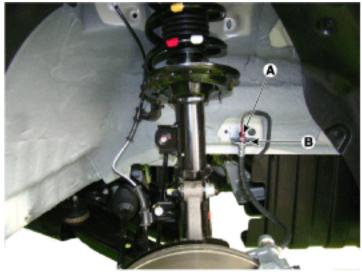
Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.

- 3. Remove the wheel & tire.
- 4. Remove the hose clip (B) and then disconnect the brake tube by loosening the tube flare nut (A).

#### **Tightening torque:**

12.7 ~ 16.7 N.m (1.3 ~ 1.7 kgf.m, 9.4 ~ 12.3 lb-ft)

#### [Front]



#### [Rear]



5. Disconnect the brake hose from the brake caliper by loosening the bolt (C).

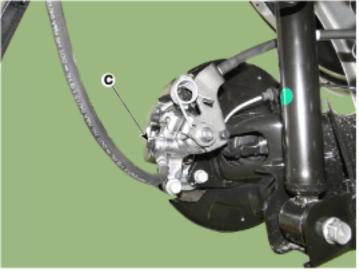
#### **Tightening torque:**

24.5 ~ 29.4 N.m (2.5 ~ 3.0 kgf.m, 18.1 ~ 21.7 lb-ft)

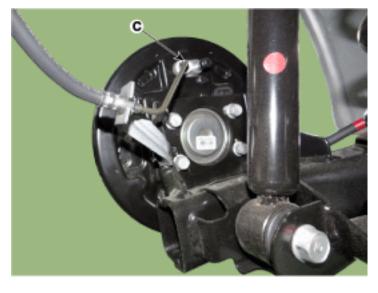
[Front]



[Rear] [Disk type]



[Drum type]

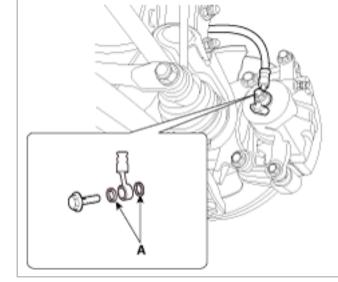


# **INSTALLATION**

1. Install in the reverse order of removal.

# NOTICE

Use a new washer (A) whenever installing.



- 2. After installation, bleed the brake system. (Refer to Brake System Bleeding)
- 3. Check the spilled brake oil.

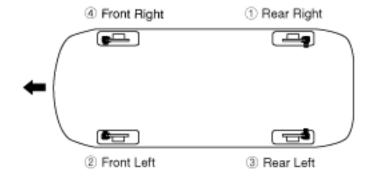
#### **INSPECTION**

- 1. Check the brake tubes for cracks, crimps and corrosion.
- 2. Check the brake hoses for cracks, damage and fluid leakage.
- 3. Check the brake tube flare nuts for damage and fluid leakage.
- 4. Check brake hose mounting bracket for crack or deformation.

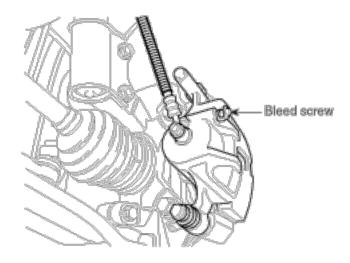
#### **BRAKE SYSTEM BLEEDING**

#### NOTICE

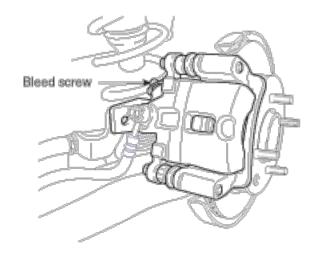
- Do not reuse the drained fluid.
- Always use Genuine DOT3/DOT4 or Brake Fluid. Using a non-Genuine DOT3/DOT4 or brake fluid can cause corrosion and decrease the life of the system.
- Make sure no dirt of other foreign matter is allowed to contaminate the brake fluid.
- Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.
- The reservoir on the master cylinder must be at the MAX (upper) level mark at the start of bleeding procedure and checked after bleeding each brake caliper. Add fluid as required.
- 1. Make sure the brake fluid level in the reservoir is at the MAX (upper) level line.
- 2. Have someone slowly pump the brake pedal several times, and then apply steady pressure.
- 3. Loosen the right-rear brake bleed screw to allow air to escape from the system. Then tighten the bleed screw securely.
- 4. Repeat the procedure for each wheel in the sequence shown below until air bubbles no longer appear in the fluid.
- 5. Refill the master cylinder reservoir to the MAX (upper) level line.



# [Front Disc Brake]

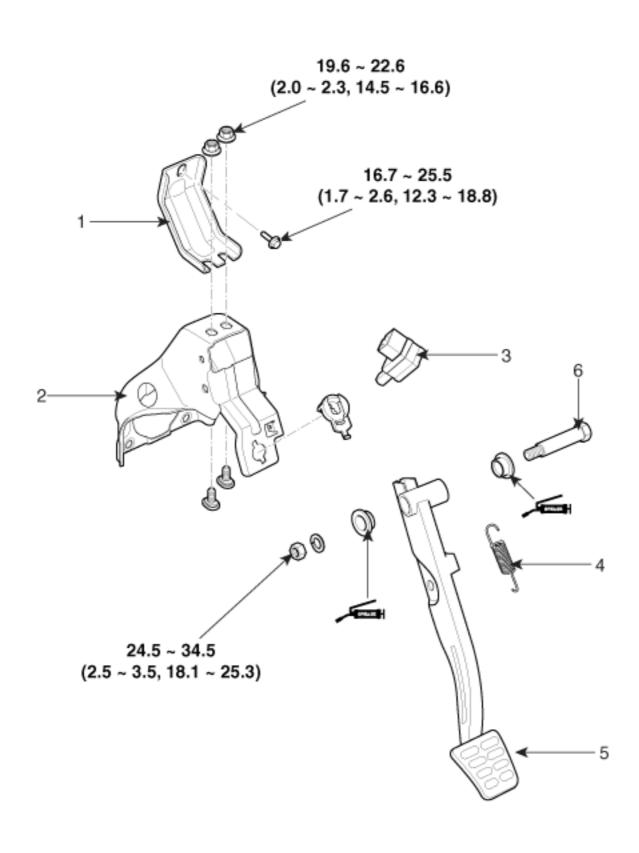


# [Rear Disc Brake]



#### **COMPONENTS**

[LHD]

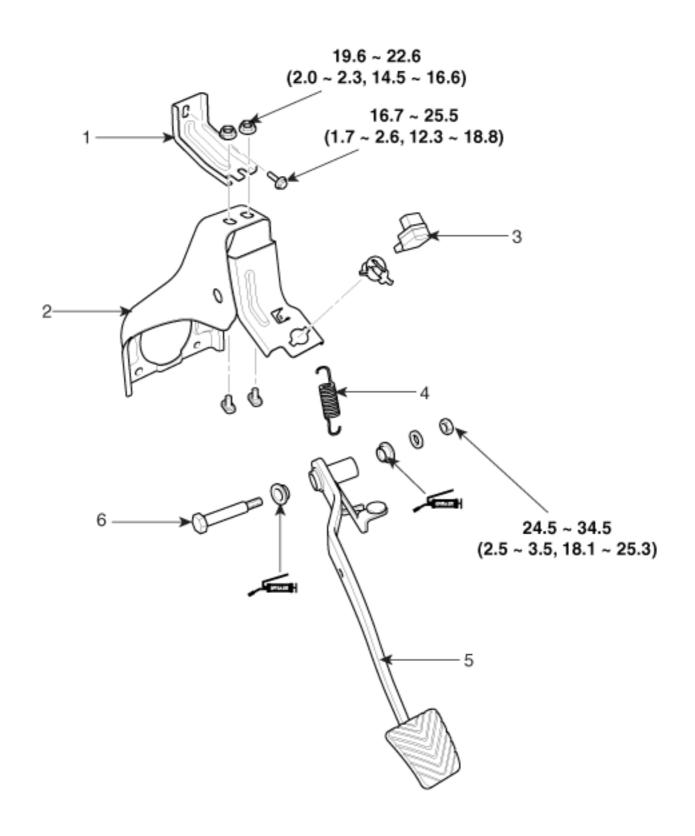


### Torque: N.m (kgf.m, lb-ft)

1	. (	Co	wl	br	ac	ket
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- 2. Brake pedal member assembly
- 3. Stop lamp switch

- 4. Return spring
- 5. Brake pedal
- 6. Bolt



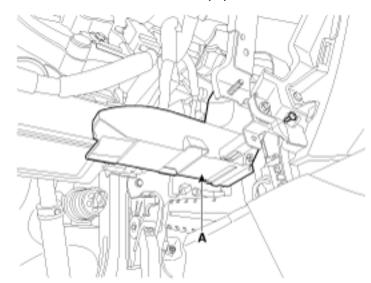
### Torque : N.m (kgf.m, lb-ft)

- 1. Cowl bracket
- 2. Brake pedal member assembly
- 3. Stop lamp switch

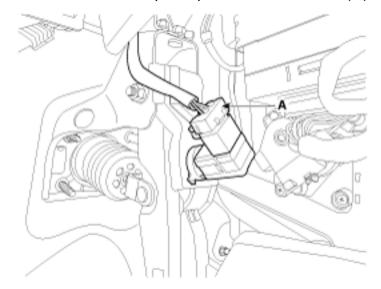
- 4. Return spring
- 5. Brake pedal
- 6. Bolt

# **REMOVAL [LHD]**

- 1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
- Remove the crash pad lower panel. (Refer to Body - "Crash Pad Lower Panel")
- 3. Remove the shower duct (A).



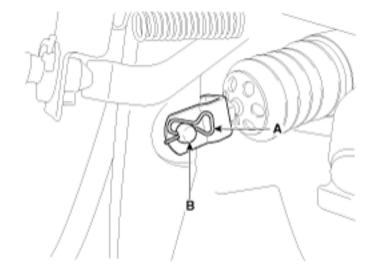
4. Disconnect the stop lamp switch connector (A).



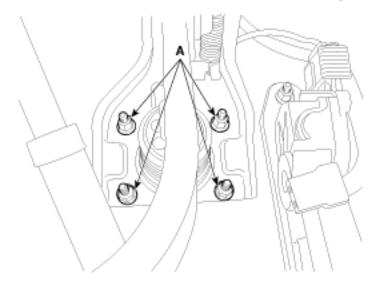
5. Remove the brake pedal member mounting bolt (A).



6. Remove the snap pin (A) and clevis pin (B).

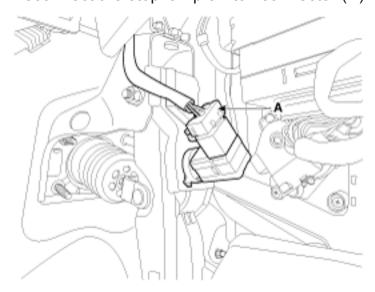


7. Remove the brake pedal member assembly mounting nuts and then remove the brake pedal assembly.



# **REMOVAL [RHD]**

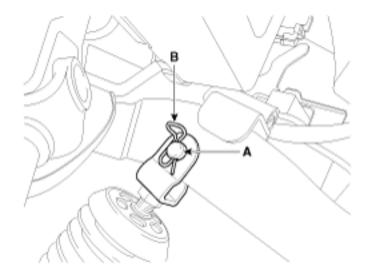
- 1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
- Remove the crash pad lower panel. (Refer to Body - "Crash Pad Lower Panel")
- Remove the junction box.
   (Refer to Body Electrical System "Relay Box")
- 4. Disconnect the stop lamp switch connector (A).



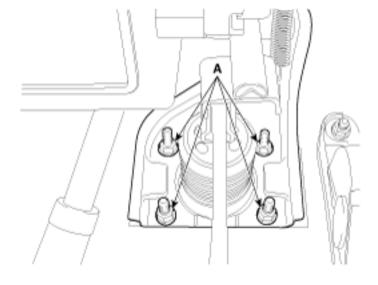
5. Remove the brake pedal member mounting bolt (A).



6. Remove the snap pin (A) and clevis pin (B).

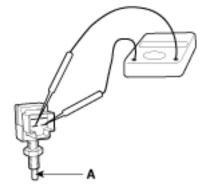


7. Remove the brake pedal member assembly mounting nuts and then remove the brake pedal assembly.



#### **INSPECTION**

- 1. Check the bushing for wear.
- 2. Check the brake pedal for bending or twisting.
- 3. Check the brake pedal return spring for damage.
- 4. Check the stop lamp switch.
  - (1) Connect a circuit tester to the connector of stop lamp switch, and check whether or not there is continuity when the plunger of the stop lamp switch is pushed in and when it is released.
  - (2) The stop lamp switch is in good condition if there is no continuity when plunger (A) is pushed.



# **INSTALLATION [LHD]**

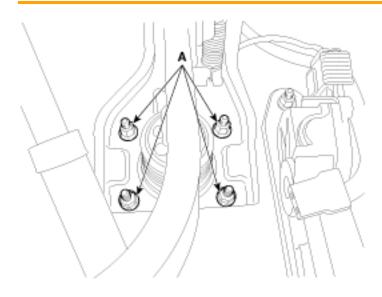
1. Pre-tighten the bracket fixing bolt (A) in dash panel.



2. Install the brake booster and brake pedal member fixing nuts (A) securely.

### Tightening torque:

16.7 ~ 25.5 N.m (1.7 ~ 2.6 kgf.m, 12.3 ~ 18.8 lb-ft)



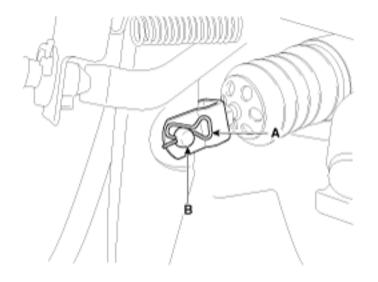
3. Tighten the bolt (A) securely in dash panel.

### Tightening torque:

16.7 ~ 25.5 N.m (1.7 ~ 2.6 kgf.m, 12.3 ~ 18.8 lb-ft)

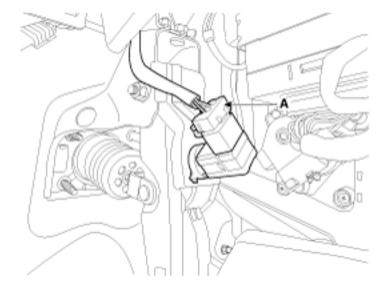


4. Install the snap pin (A) and clevis pin (B).

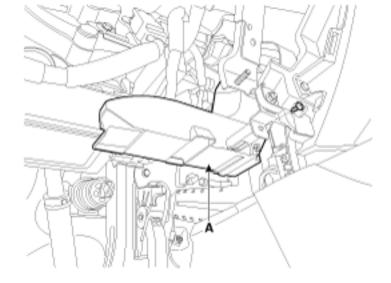


# **▲** CAUTION

- Before installing the pin, apply the grease to the clevis pin.
- Use a new snap pin whenever installing.
- 5. Install the stop lamp switch securely.
- 6. Connect the stop lamp switch connector (A).



- 7. Adjust the brake pedal height and free play.
- 8. Check the brake pedal operation after installing the brake pedal.
- 9. Install the shower duct (A).



- Install the crash pad lower panel.
   (Refer to Body "Crash Pad Lower Panel")
- 11. Reconnect the battery negative cable.

# **INSTALLATION [RHD]**

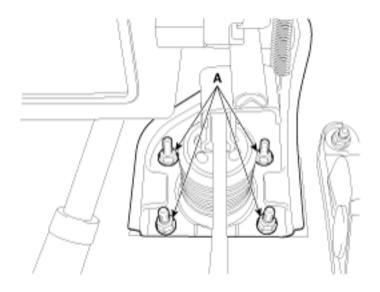
1. Pre-tighten the bracket fixing bolt (A) in dash panel.



2. Install the brake booster and brake pedal member fixing nuts (A) securely.

### Tightening torque:

16.7 ~ 25.5 N.m (1.7 ~ 2.6 kgf.m, 12.3 ~ 18.8 lb-ft)



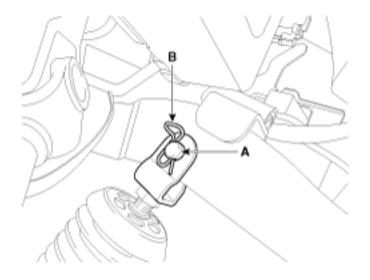
3. Tighten the bolt (A) securely in dash panel.

#### **Tightening torque:**

16.7 ~ 25.5 N.m (1.7 ~ 2.6 kgf.m, 12.3 ~ 18.8 lb-ft)

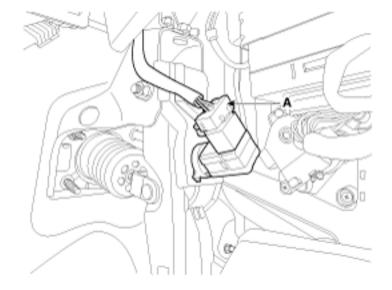


4. Install the snap pin (A) and clevis pin (B).



# **▲** CAUTION

- Before installing the pin, apply the grease to the clevis pin.
- Use a new snap pin whenever installing.
- 5. Install the stop lamp switch securely.
- 6. Connect the stop lamp switch connector (A).



- 7. Adjust the brake pedal height and free play.
- 8. Check the brake pedal operation after installing the brake pedal.
- Install the junction box.
   (Refer to Body Electrical System- "Relay Box")
- Install the crash pad lower panel.
   (Refer to Body "Crash Pad Lower Panel")

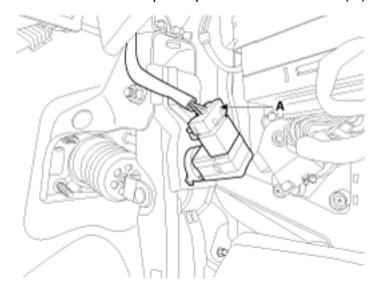
11. Reconnect the battery negative cable.

### **ADJUSTMENT**

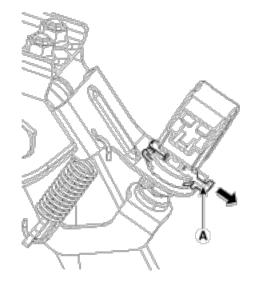
### Stop lamp switch clearance adjustment

If the gap between stop lamp switch and bracket is not 1.0~2.0mm (0.04~0.08in), conform to below.

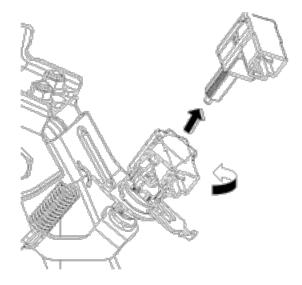
1. Disconnect the stop lamp switch connector (A).



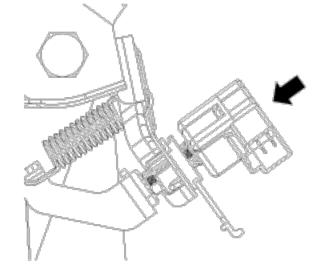
2. Pull the locking plate (A) as indicated by the arrow.



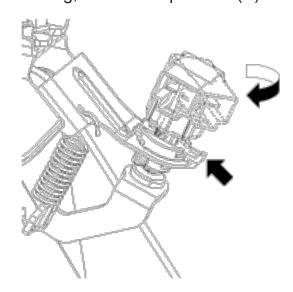
3. Turn stop lamp switch  $45^{\circ}$  counterclockwise and remove it.



4. Fix the brake pedal arm and insert fully the stop lamp switch as hiding contact part.



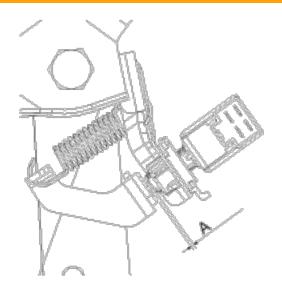
5. After inserting, turn the stop switch (A) 45° clockwise, and then assemble locking plate (B) by pushing.



6. Confirm the gap between stop lamp switch and bracket.

### Stop lamp clearance:

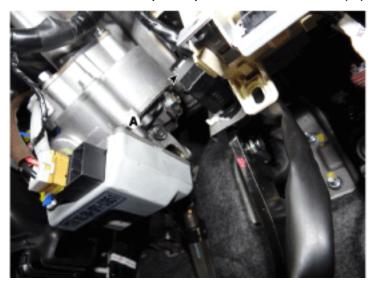
1.0 ~ 2.0 mm (0.04~ 0.08 in.)



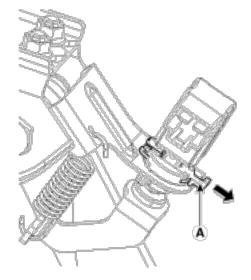
7. Connect the stop lamp switch connector.

### **REMOVAL**

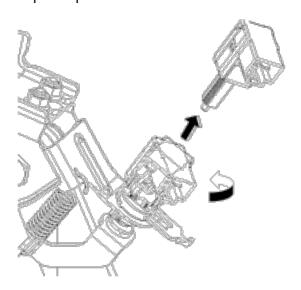
- 1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
- Remove the lower crash pad. (Refer to Body - "Crash Pad")
- 3. Disconnect the stop lamp switch connector (A).



4. Pull the locking plate (A) as indicated by the arrow.

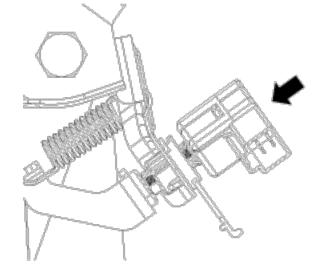


5. Turn stop lamp switch 45° counterclockwise and remove it.

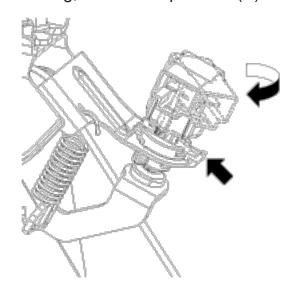


### **INSTALLATION**

1. Fix the brake pedal arm and insert fully the stop lamp switch as hiding contact part.

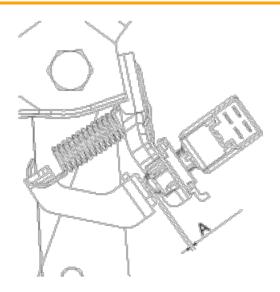


2. After inserting, turn the stop switch (A) 45° clockwise, and then assemble locking plate (B) by pushing.



3. Confirm the gap between stop lamp switch and bracket.

**Stop lamp clearance :** 1.0 ~ 2.0 mm (0.04~ 0.08 in.)



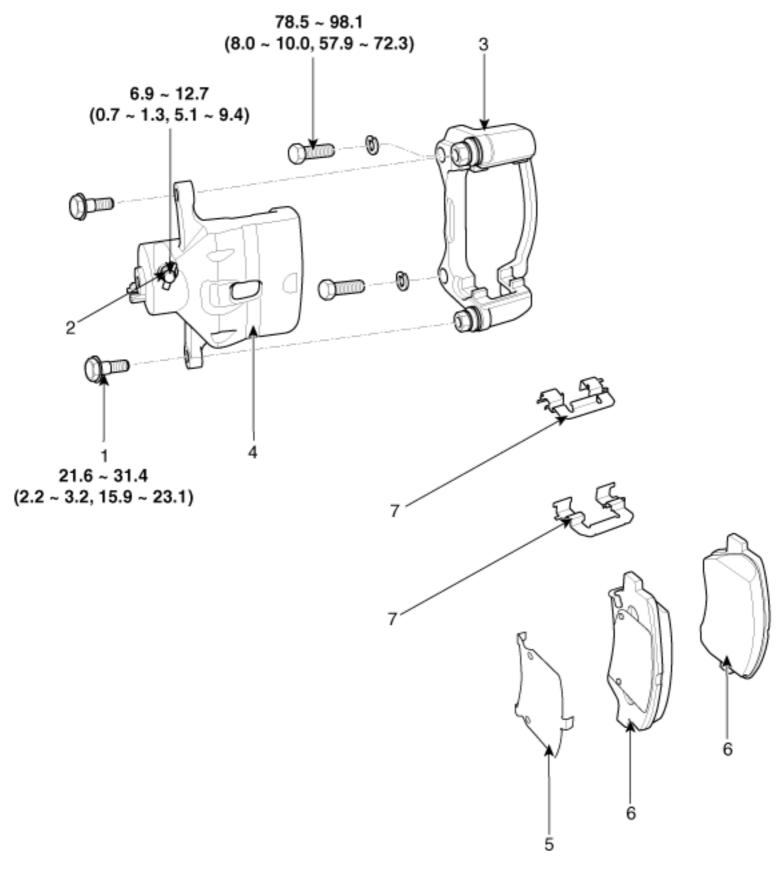
4. Connect the stop lamp switch connector.

### NOTICE

If the gap between stop lamp switch and bracket is not 1.0~2.0mm (0.04~0.08in), perform the above process again.

Install the lower crash pad. (Refer to the Body - "Crash Pad")

#### **COMPONENTS**



Torque: N.m (kgf.m, lb-ft)

1. Brake caliper

2. Brake disc

3. Pad spring

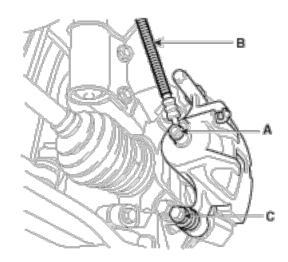
4. Guide rod bolt

5. Brake pad

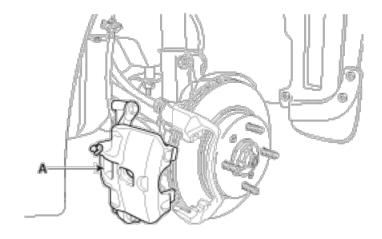
6. Brake pad shim

# **REMOVAL**

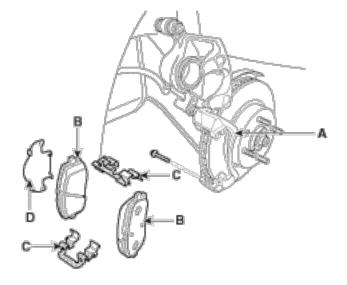
1. Remove the brake hose bolt (B) and the guide rod bolts (C) from the caliper assembly (A).



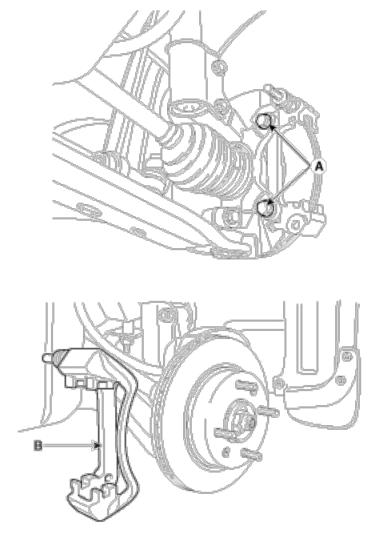
2. Remove the caliper assembly (A).



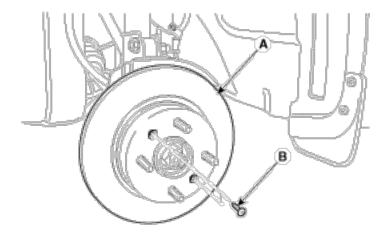
3. Remove the pads (B), the pad shims (C) and the pad springs (D) from the caliper carrier (A).



4. Remove the caliper carrier (B) and the caliper mounting bolts (A).



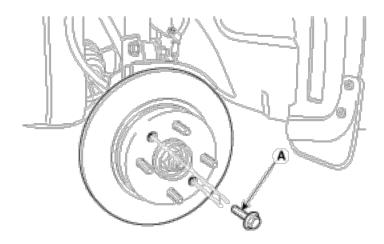
5. Remove the brake disc (A) and the screw (B).



# NOTICE

Remove the brake disc from hub using M8 bolt (A) if the brake disc has been seized with the hub due to corrosion or overheat.

Be careful not to use the hammer. The disc can be damaged if you remove the disc from the hub by hammer.

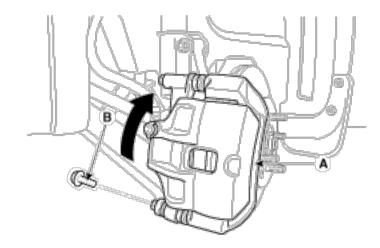


#### **REPLACEMENT**

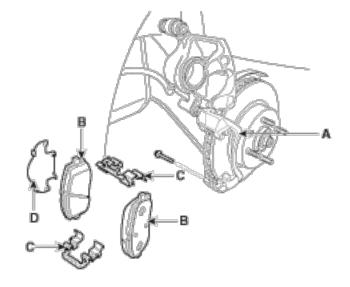
### NOTICE

Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

- Avoid breathing dust particles.
- Never use on air hose or brush to clean brake assemblies.
- 1. Remove guide rod bolt (B) and raise the caliper assembly (A).



2. Remove the pads (B), the pad shims (C) and the pad springs (D) from the caliper carrier (A).



#### **INSPECTION**

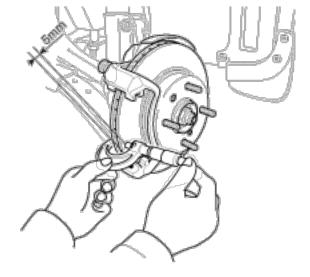
### Front Brake Disc Thickness Check

1. Remove all rust and contamination from the disc surface, and then measure the disc thickness at 8 positions at least.

#### Front brake disc thickness

Standard value: 18.0 mm (0.71 in)

Limit: 16.0 mm (0.63 in)



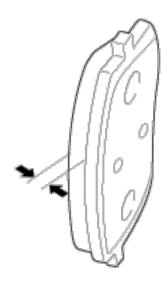
- 2. Thickness variation should not exceed 0.005 mm (0.0002in) (circumference) and 0.01 mm(0.0004 in) (radius) at any directions.
- 3. If wear exceeds the limit, replace the discs and pad assemblies for left and right of the vehicle.

### Front Brake Pad Check

1. Check the pad wear. Measure the pad thickness. replace it if it is less than the specified value.

#### Pad thickness

Standard value: 10.0 mm (0.39 in) Service limit: 2.0 mm (0.0787 in)



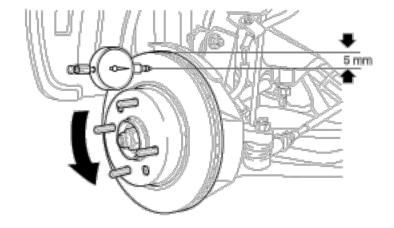
2. Check that grease is applied, to sliding contact points and the pad and backing metal for damage.

#### Front Brake Disc Run Out Check

1. Place a dial gauge about 5mm (0.2 in) from the outer circumference of the brake disc, and measure the run out of the disc.

#### Brake disc run out

Limit: 0.04 mm (0.0020 in) or less



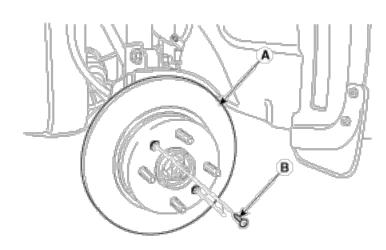
- 2. If the run out of the brake disc exceeds the limit specification, replace the disc, and then measure the run out again.
- 3. If the run out does not exceed the limit specification, install the brake disc after turning it and then check the run out of the brake disc again.
- 4. If the run out cannot be corrected by changing the position of the brake disc, replace the brake disc.

### **INSTALLATION**

1. Install the brake disc (A) and tighten the screw (B).

#### Tightening torque:

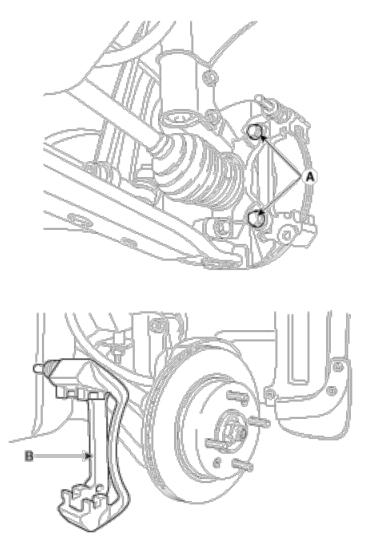
 $4.9 \sim 5.9 \text{ N.m}$  (0.5 ~ 0.6 kgf.m, 3.6 ~ 4.3 lb-ft)



2. Install the caliper carrier (B) and tighten the caliper mounting bolts (A).

#### Tightening torque:

78.5 ~ 98.1 N.m (8.0 ~ 10.0 kgf.m, 57.9 ~ 72.3 lb-ft)

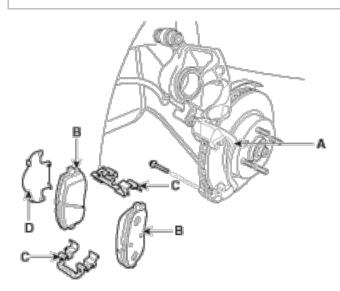


3. Install the pad springs (D) to the caliper carrier (A).

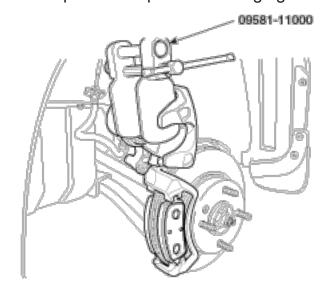
4. Install the brake pads (B) and pad shims (C) on the pad springs correctly. Install the pad with the wear indicator on the inside. If you are reusing the pads, always reinstall the brake pads in their original positions to prevent a momentary loss of braking efficiency.

### **NOTICE**

Check the foreign material at the pad shims (A) and the back of the pads (B). Contaminated brake discs or pads reduce stopping ability. Keep grease off the discs and pads.



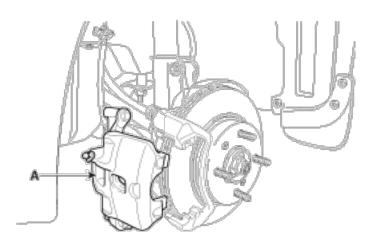
5. Push in the piston using the SST (09581-11000) so that the caliper will fit over the pads. Make sure that the piston boot is in position to prevent damaging it when installing the caliper.



6. Install the caliper assembly (A).

#### **NOTICE**

Be careful not to damage the piston pin boot.

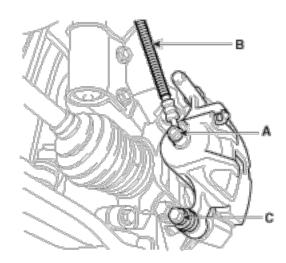


7. Install the brake hose bolt (B) and the guide rod bolts (C) to the caliper assembly (A).

#### **Tightening torque**

Bolt (B):

 $24.5 \sim 29.4$  N.m ( $2.5 \sim 3.0$  kgf.m,  $18.1 \sim 21.7$  lb-ft) Bolt (C) :  $21.6 \sim 31.4$  N.m ( $2.2 \sim 3.2$  kgf.m,  $15.9 \sim 23.1$  lb-ft)



- 8. Refill the master cylinder reservoir to the MAX line.
- Bleed the brake system.(Refer to "Bleeding of Brake System")
- 10. Depress the brake pedal several times to make sure the brakes work, then test-drive.

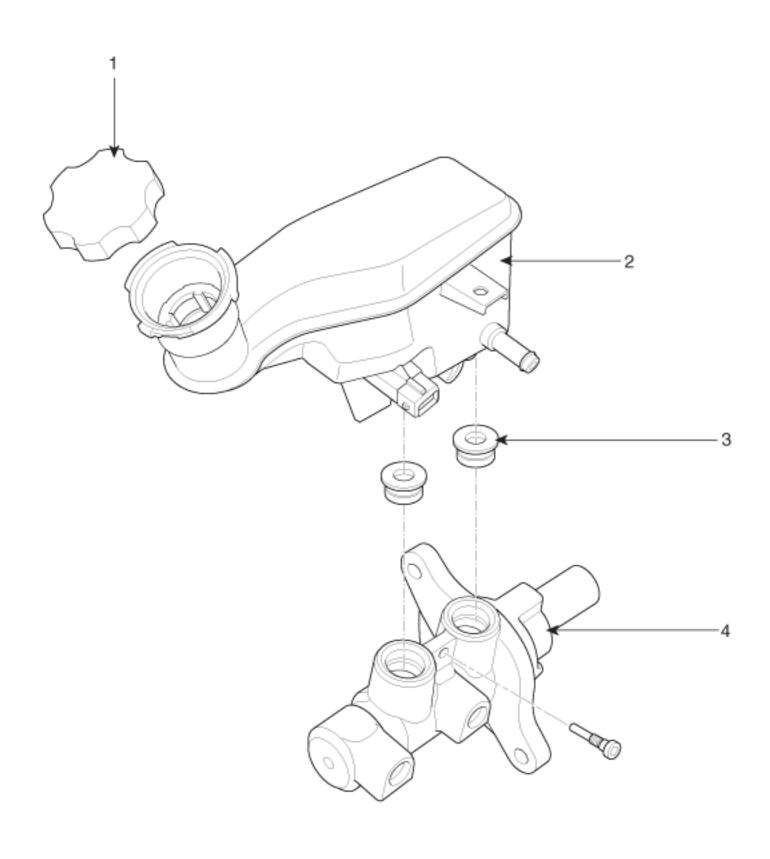
### NOTICE

Engagement of the brake may require a greater pedal stroke immediately after the brake pads have been replaced as a set. Several applications of the brake will restore the normal pedal stroke.

11. After installation, check for leaks at hose and line joints or connections, and retighten if necessary.

# **COMPONENTS**

[LHD]



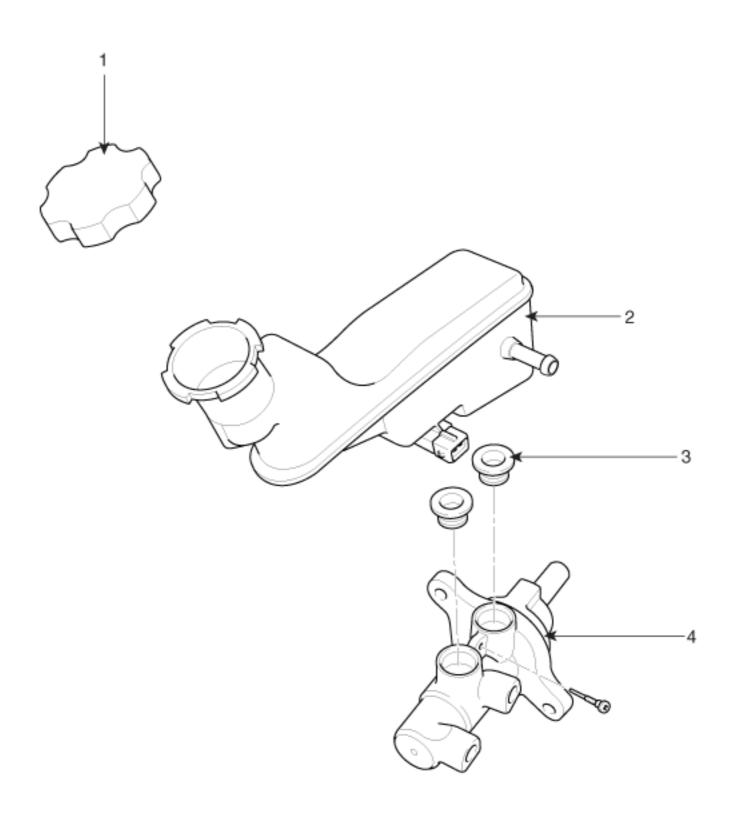
1. Res	ervoir	cap
--------	--------	-----

2. Reservoir

3. Grommet

4. Master cylinder

[RHD]



1. Reservoir cap

2. Reservoir

3. Grommet

4. Master cylinder

#### **REMOVAL**

- 1. Turm ignition switch OFF and disconnect the negative (-) battery cable.
- 2. Remove the battery (A) and ECM (B). [LHD] (Refer to Engine Electrical System - "Battery")



- 3. Remove the air cleaner assembly. [RHD] (Refer to Engine and Transaxle Assembly - "Air Cleaner")
- 4. Remove the brake fluid from the master cylinder reservoir.

### NOTICE

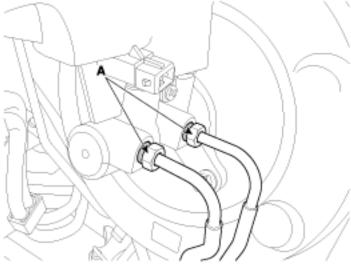
Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.

5. Disconnect the brake fluid level switch connector (A).

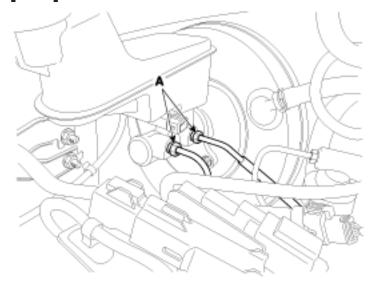




6. Disconnect the brake tube (A) from the master cylinder by loosening the tube flare nut. **[LHD]** 



[RHD]



7. Remove the master cylinder (B) from the brake booster after loosening the mounting nuts (A).

# Tightening torque:

12.7 ~ 16.7 N.m (1.3 ~ 1.7 kgf.m, 9.4 ~ 12.3 lb-ft)

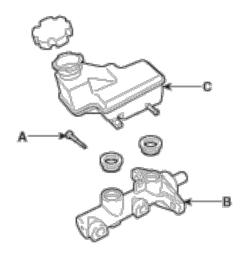


#### **INSTALLATION**

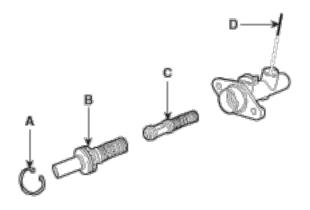
- 1. Installation is the reverse of removal.
- After installation, bleed the brake system.
   (Refer to Brake System "Brake System Bleeding")

#### **DISASSEMBLY**

- 1. Remove the reservoir cap and drain the brake fluid into a suitable container.
- 2. Remove the reservoir (C) from the master cylinder (B) after remove the mounting screw (A).



- 3. Remove the retainer ring (A) by using the snap ring pliers.
- 4. Remove the primary piston assembly (B).
- 5. Remove the pin (D) with the secondary piston (C) pushed completely using a screwdriver. Remove the secondary piston assembly (C).



#### **NOTICE**

Do not disassemble the primary and secondary piston assembly.

#### **INSPECTION**

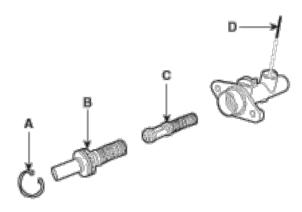
- 1. Check the master cylinder bore for rust or scratch.
- 2. Check the master cylinder for wear or damage. If necessary, clean or replace the cylinder.

#### NOTICE

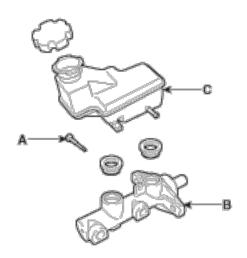
- 1) If the cylinder bore is damaged, replace the master cylinder assembly.
- 2) Wash the contaminated parts in alcohol.

#### **REASSEMBLY**

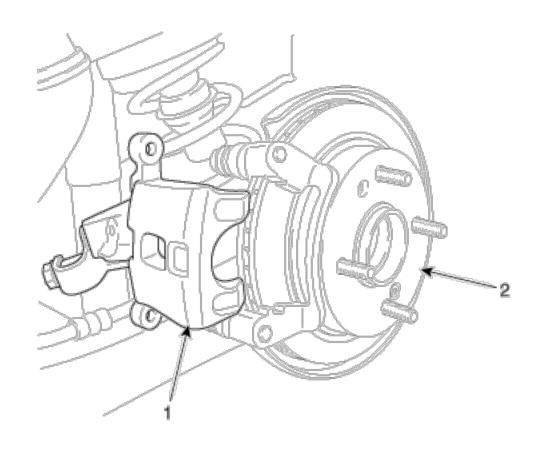
- 1. Apply genuine brake fluid to the rubber parts of the cylinder kit and grommets.
- 2. Carefully insert the springs and pistons in the proper direction.
- 3. Press the secondary piston (C) with a screwdriver and install the cylinder pin (D).

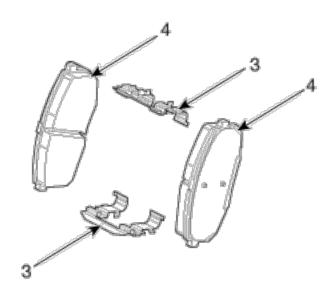


- 4. Install the primary piston assembly (B) and the retainer ring (A).
- 5. Mount two grommets (D).
- 6. Install the reservoir (C) to the master cylinder (B) and tighten the screw (A).



# **COMPONENT LOCATION**

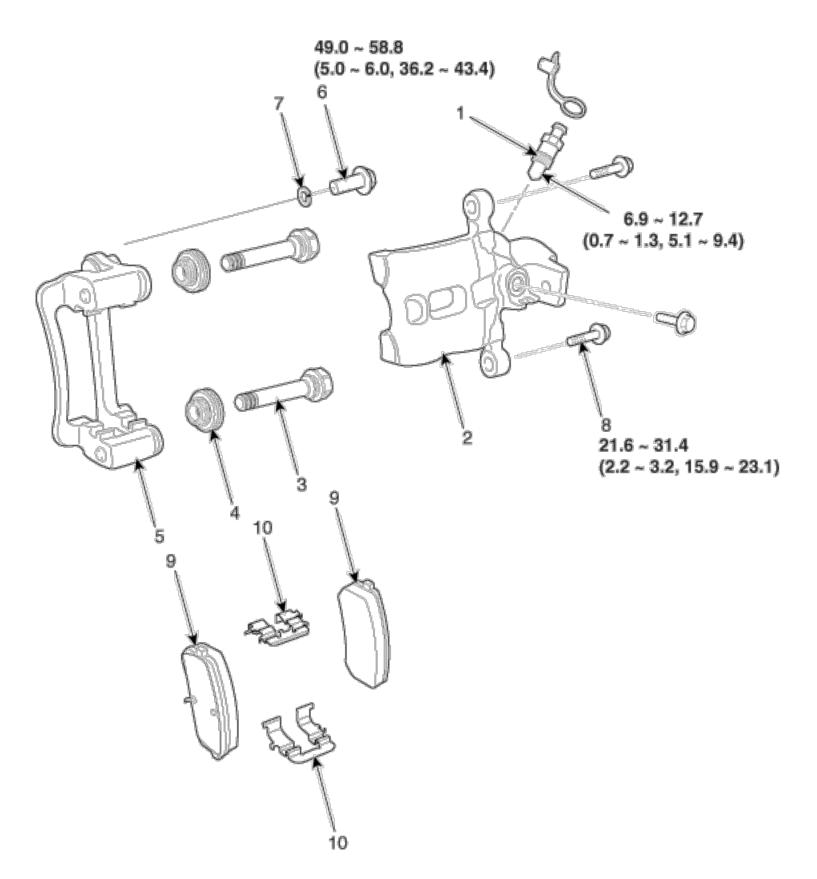




- 1. Brake caliper
- 2. Brake disc

- 3. Pad spring
- 4. Brake pad

### **COMPONENTS**



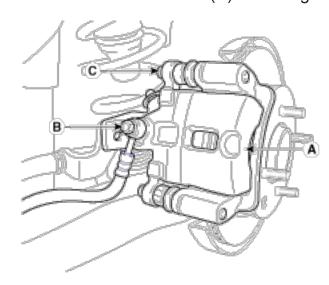
# Torque: N.m (kgf.m, lb-ft)

- 1. Bleeder screw
- 2. Caliper housing
- 3. Guide rod
- 4. Boot
- 5. Caliper carrier

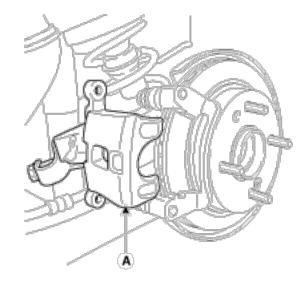
- 6. Caliper mounting bolt
- 7. Washer
- 8. Guide rod bolt
- 9. Brake Pad
- 10. Pad spring

# **REMOVAL**

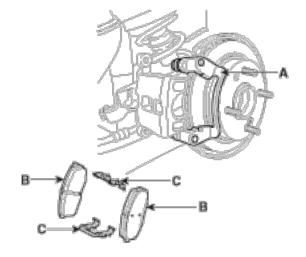
1. Remove the brake hose bolt (B) and the guide rod bolts (C) from the caliper assembly (A).



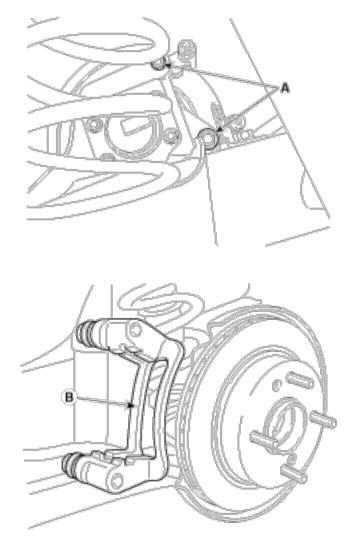
2. Remove the caliper assembly (A).



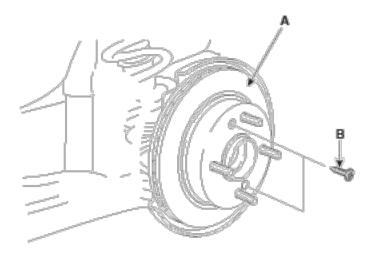
3. Remove the pads (B), the pad springs (D) from the caliper carrier (A).



4. Remove the caliper carrier (B) and the caliper mounting bolts (A).



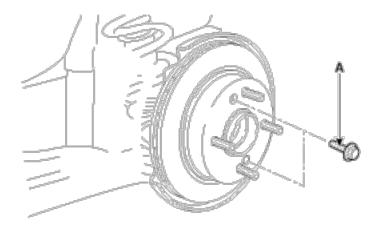
5. Remove the brake disc (A) and the screw (B).



# NOTICE

Remove the brake disc from hub using M8 bolt (A) if the brake disc has been seized with the hub due to corrosion or overheat.

Be careful not to use the hammer. The disc can be damaged if you remove the disc from the hub by hammer.

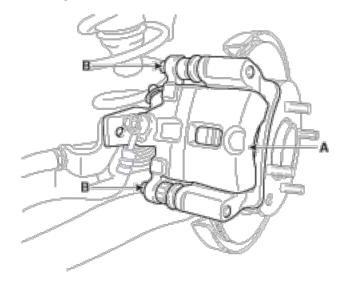


#### **REPLACEMENT**

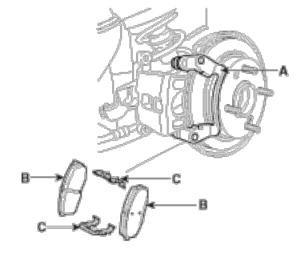
### NOTICE

Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

- · Avoid breathing dust particles.
- Never use on air hose or brush to clean brake assemblies.
- 1. Remove guide rod bolt (B) and raise the caliper assembly (A).



2. Remove the pads (B), the pad shims (C) and the pad springs (D) from the caliper carrier (A).



#### **INSPECTION**

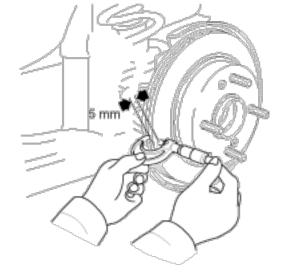
#### Rear Brake Disc Thickness Check

1. Remove all rust and contamination from the disc surface, and then measure the disc thickness at 8 positions at least.

Rear brake disc thickness

Standard value: 10.0 mm (0.39 in)

Limit: 8.4 mm (0.33 in)



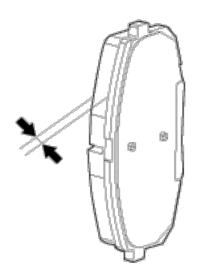
- 2. Thickness variation should not exceed 0.01mm (0.0004in) (circumference) and 0.01mm (0.0004in) (radius) at any directions.
- 3. If wear exceeds the limit, replace the discs and pad assemblies for left and right of the vehicle.

### Rear Brake Pad Check

1. Check the pad wear. Measure the pad thickness. replace it if it is less than the specified value.

#### Pad thickness

Standard value: 9.0 mm (0.39 in) Service limit: 2.0 mm (0.0787 in)



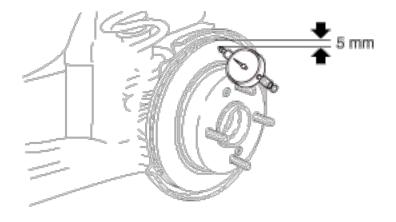
2. Check that grease is applied, to sliding contact points and the pad and backing metal for damage.

### Rear Brake Disc Run Out Check

1. Place a dial gauge about 5mm (0.2 in) from the outer circumference of the brake disc, and measure the run out of the disc.

#### Brake disc run out

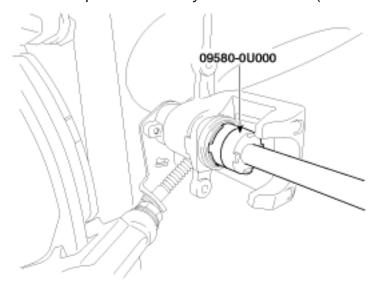
Limit: 0.05 mm (0.0020 in) or less



- 2. If the run out of the brake disc exceeds the limit specification, replace the disc, and then measure the run out again.
- 3. If the run out does not exceed the limit specification, install the brake disc after turning it and then check the run out of the brake disc again.
- 4. If the run out cannot be corrected by changing the position of the brake disc, replace the brake disc.

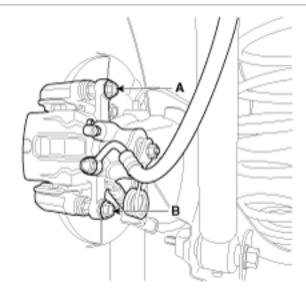
#### **INSTALLATION**

- 1. Install in the reverse order of removal.
- 2. Insert the piston in the cylinder the SST (09580-0U000).



# NOTICE

- Wind the piston into the caliper body until it is fully retracted.
- Do not use any power assisted tools for this task.
- Manually insert new screws from the brake pad and tighten the leading-pin bolt (A) first with specified torque, following this tighten the trailing-pin bolt (B) in the same manner.



3. After installation, bleed the brake system. (Refer to Brake System - "Brake System Bleeding")

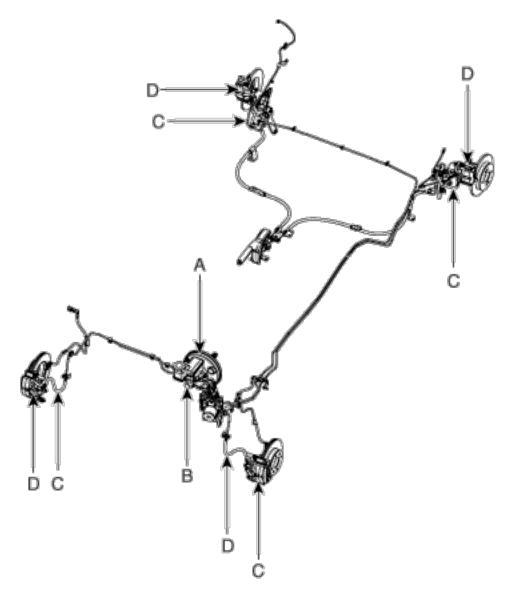
### NOTICE

- Bring the brake pads in their operating position by pressing the brake pedal down (half of normal pedal travel) several times until there is resistance.
- In order to bed the brake pads to the brake disc and ensure performance and endurance, the vehicle user must be instructed to avoid heavy braking or sustained periods with the brakes applied, for the first 200km (124mile) after installing new pads.

	arking brake cable	e or brake disc	s have been	changed.		

# **OPERATION AND LEAKAGE CHECK**

Component	Procedure			
Brake Booster (A)	Check brake operation by applying the brakes during a test drive. If the brakes do not work properly, check the brake booster. Replace the brake booster as an assembly if it does not work properly or if there are signs of leakage.			
Piston cup and pressure cup	Check brake operation by applying the brakes. Look for damage or signs of fluid leakage. Replace the master cylinder as an assembly if the pedal does not work properly or if there is damage or signs of fluid leakage.			
inspection (B)	Check for a difference in brake pedal stroke between quick and slow brake applications. Replace the master cylinder if there is a difference in pedal stroke			
Brake hoses (C)	Look for damage or signs of fluid leakage. Replace the brake hose with a new one if it is damaged or leaking.			
	Check brake operation by applying the brakes.			
Caliper piston seal and piston boots (D)	Look for damage or signs of fluid leakage. If the pedal does not work properly, the brakes drag, or there is damage or signs of fluid leakage, disassemble and inspect the brake caliper. Replace the boots and seals with new ones whenever the brake caliper is disassembled.			



# **Brake System Bleeding**

## NOTICE

- Do not reuse the drained fluid.
- Always use genuine DOT3/DOT4 brake Fluid. Using a non-genuine DOT3/DOT4 brake fluid can cause corrosion and decrease the life of the system.
- Make sure no dirt or other foreign matter is allowed to contaminate the brake fluid.
- Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off

- immediately with water.
- The reservoir on the master cylinder must be at the MAX (upper) level mark at the start of bleeding procedure and checked after bleeding each brake caliper. Add fluid as required.
- 1. Make sure the brake fluid in the reservoir is at the MAX (upper) level line.
- 2. Have someone slowly pump the brake pedal several times, and then apply pressure.
- 3. Loosen the right-rear brake bleed screw (A) to allow air to escape from the system. Then tighten the bleed screw securely. **[Front]**



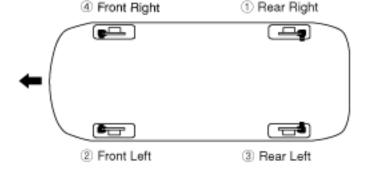
[Rear]
[Disc type]



[Drum type]



4. Repeat the procedure for wheel in the sequence shown below until air bubbles no longer appear in the fluid.



5. Refill the master cylinder reservoir to MAX (upper) level line.

### ABS Bleeding of Brake System

This procedure should be followed to ensure adequate bleeding of air and filling of the ABS unit, brake lines and master cylinder with brake fluid.

1. Remove the reservoir cap and fill the brake reservoir with brake fluid.

### NOTICE

If there is any brake fluid on any painted surface, wash it off immediately.

When pressure bleeding, do not depress the brake pedal.

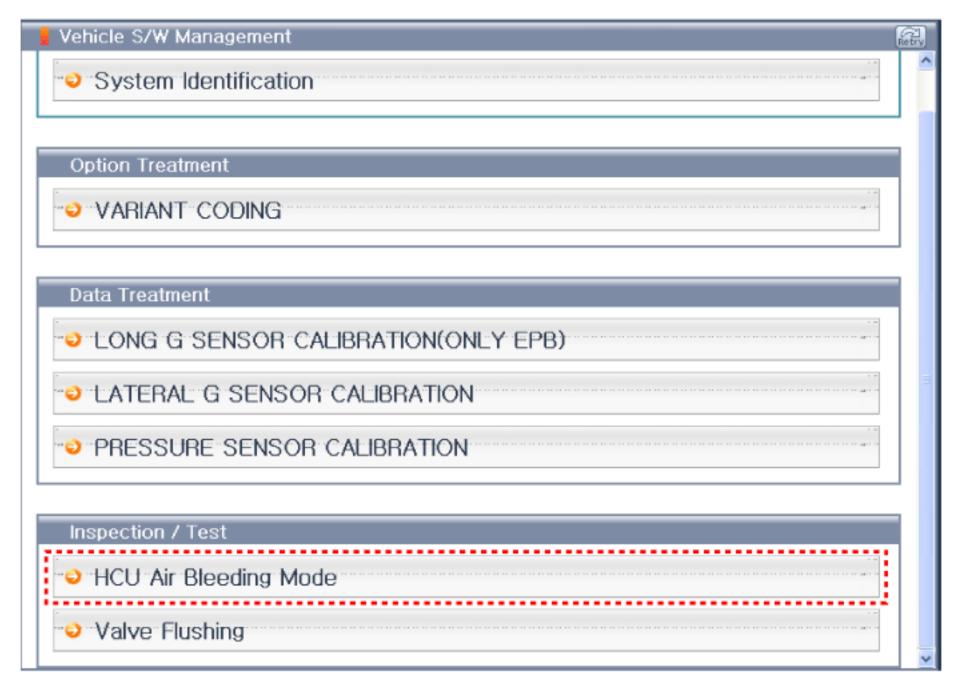
Recommended fluid...... DOT3 or DOT4

- Connect a clear plastic tube to the wheel cylinder bleeder plug and insert the other end of the tube into a half filled clear plastic bottle.
- 3. Connect the GDS to the data link connector located underneath the dash panel.
- 4. Select and operate according to the instructions on the GDS screen.

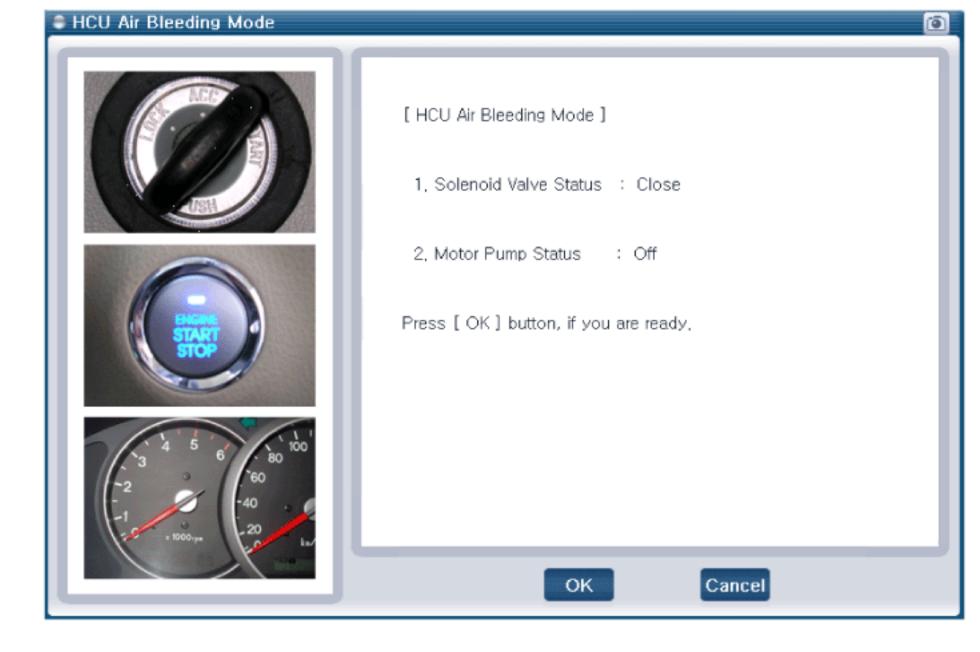
### NOTICE

You must obey the maximum operating time of the ABS motor with the GDS to prevent the motor pump from burning.

- (1) Select vehicle name.
- (2) Select Anti-Lock Brake system.
- (3) Select HCU air bleeding mode.



(4) Press "OK" to operate motor pump and solenoid valve.

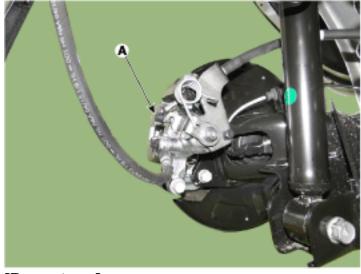


5. Pump the brake pedal several times, and then loosen the bleeder screw until fluid starts to run out without bubbles. Then close the bleeder screw (A).

### [Front]



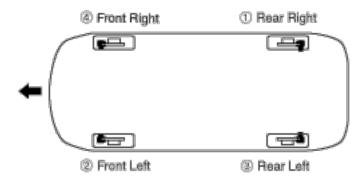
[Rear] [Disc type]



[Drum type]



6. Repeat step 5 until there are no more bubbles in the fluid for each wheel.

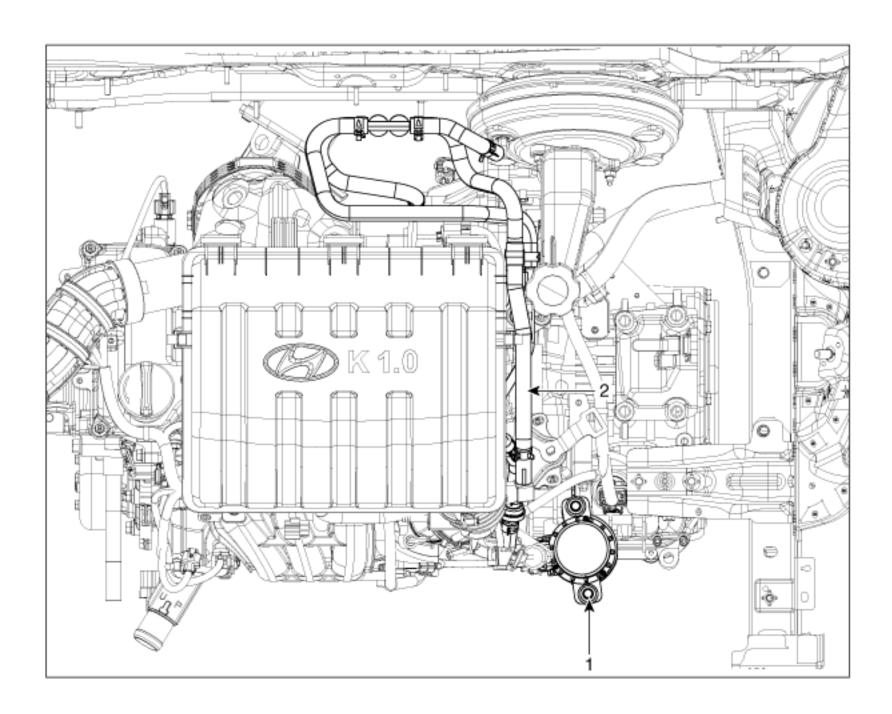


7. Tighten the bleeder screw.

# Bleed screw tightening torque :

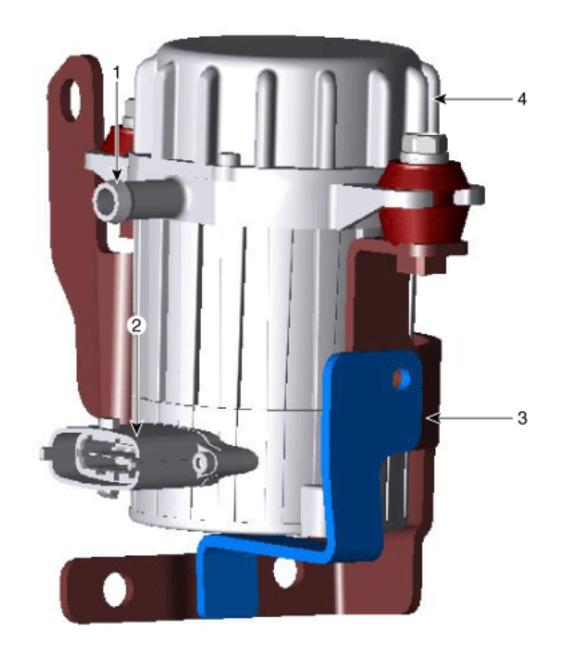
7.0 ~ 13.0 N.m (0.7 ~ 1.3 kgf.m, 5.4 ~ 9.5 lb-ft)

# **COMPONENTS LOCATION**



1. Vacuum pump 2. Vacuum hose

# **COMPONENTS**



1. Vacuum port

2. Connector

3. Bracket

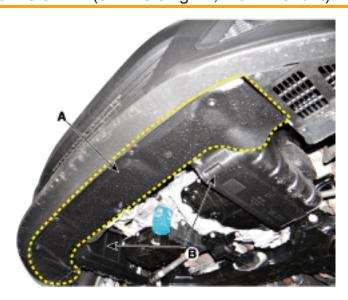
4. Motor assembly

## **REMOVAL**

- 1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
- 2. Raise the vehicle, and make sure it is securely supported.
- 3. Remove the engine room under cover (A) and side cover (B).

#### **Tightening torque:**

 $3.9 \sim 5.9 \text{ N.m} (0.4 \sim 0.6 \text{ kgf.m}, 2.9 \sim 4.3 \text{ lb-ft})$ 



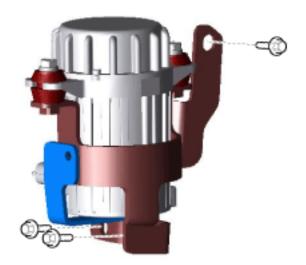
- 4. Disconnect the vacuum pump connector.
- 5. Remove the fixed clip and then disconnect the vacuum hose (A).



6. Loosen the mounting bolt and then remove the vacuum pump.

### Tightening torque:

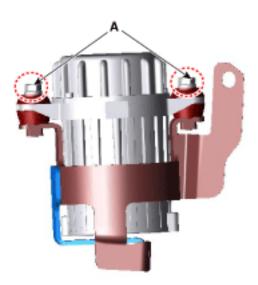
9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)



7. Loosen the mounting bolt (A) and then separate the vacuum pump from the bracket.

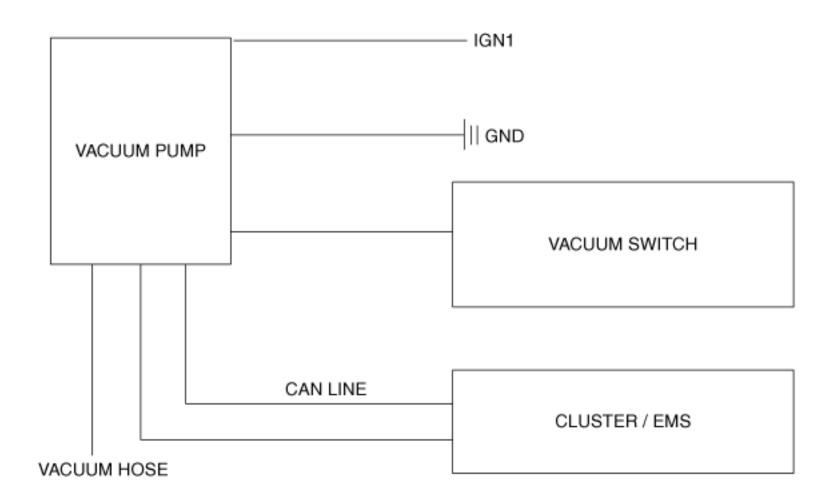
# Tightening torque:

9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)

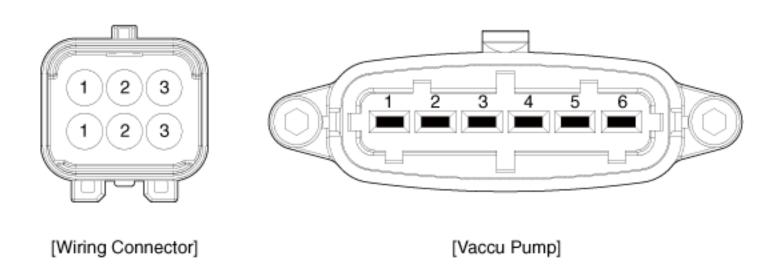


8. To install, reverse the removal procedure.

## **CIRCUIT DIAGRAM**



## **TERMINAL FUNCTION**



PIN No Function Wire color

1	Ground	BLACK
2	CAN High	WHITE
3	CAN Low	YELLOW
4	Vacuum sensor	PINK
5	IGN 1	RED
6	-	-

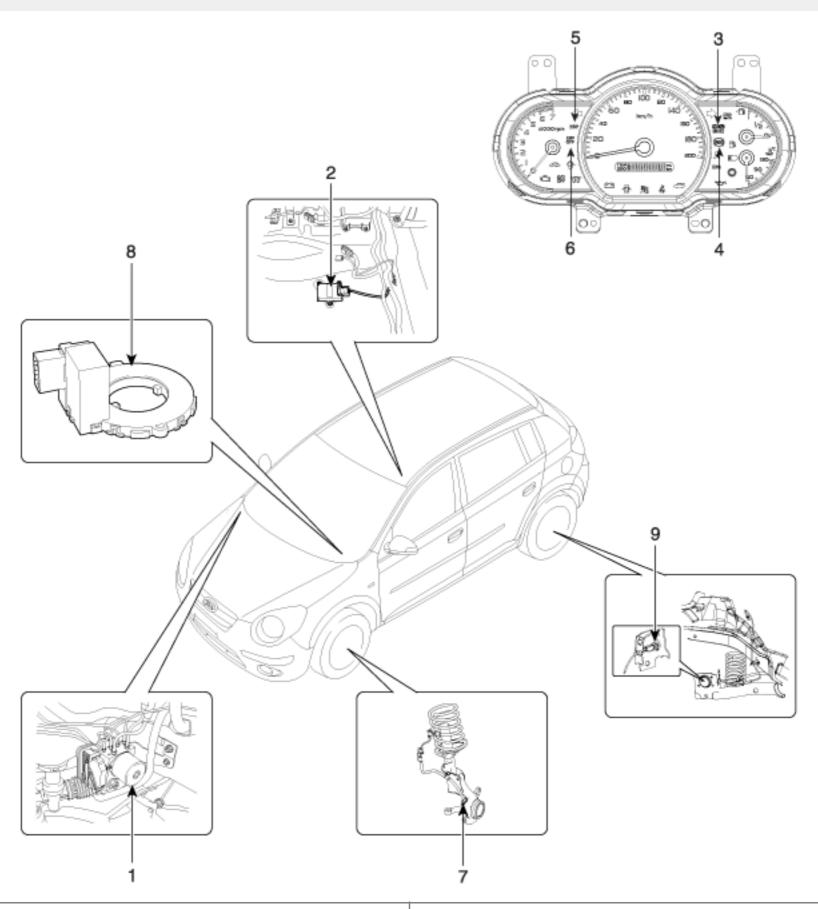
2016 > G 1.2 MPI > G 1.2 MPI > Brake System > Brake System > Vacuum Pump > Specifications

# **SPECIFICATIONS**

Item	Specification
Rated voltage	12.5 ± 0.1V
Nominal current	10A, at 400 msec.
Basic Performance	The negative pressure of vacuum pump must rise to 385mmHg within 5 seconds or less.

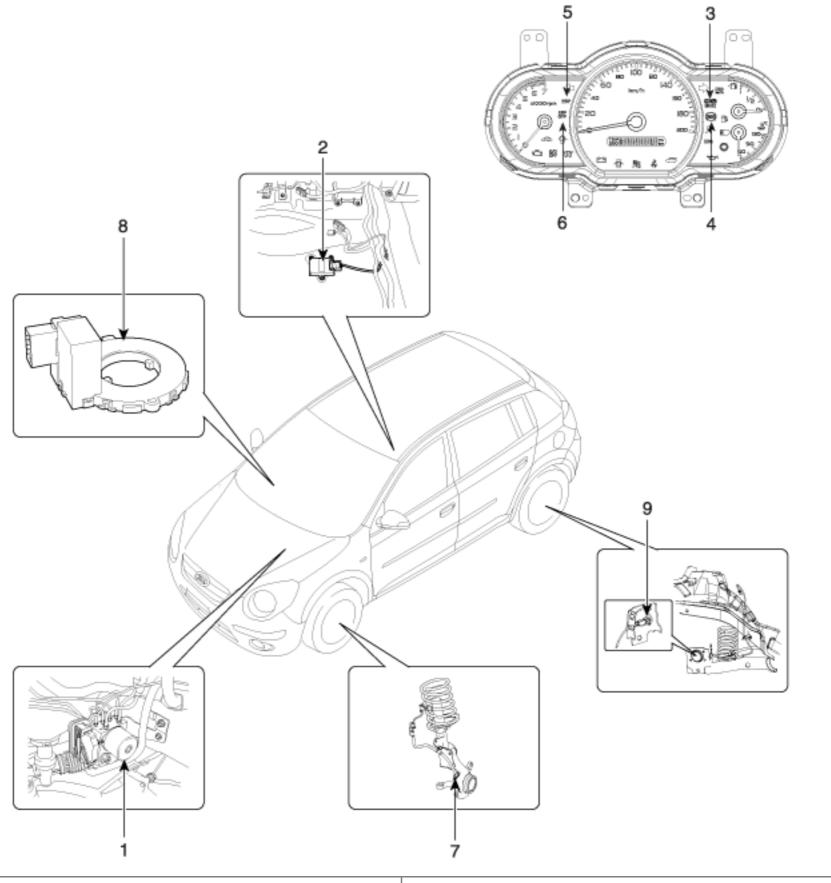
## **COMPONENTS**

### [LHD]



- 1. HECU module
- 2. Yaw rate & Lateral G sensor
- 3. Parking brake/EBD warning lamp
- 4. ABS Warning lamp
- 5. ESP function lamp

- 6. ESP OFF warning lamp
- 7. Front wheel speed sensor
- 8. Steering angle sensor
- 9. Rear wheel speed sensor



- 1. HECU module
- 2. Yaw rate & Lateral G sensor
- 3. Parking brake/EBD warning lamp
- 4. ABS Warning lamp5. ESP function lamp

- 6. ESP OFF warning lamp
- 7. Front wheel speed sensor
- 8. Steering angle sensor
- 9. Rear wheel speed sensor

#### **DESCRIPTION OF ESP**

Optimum driving safety now has a name: ESP, the Electronic Stability Program.

ESP recognizes critical driving conditions, such as panic reactions in dangerous situations, and stabilizes the vehicle by wheel-individual braking and engine control intervention.

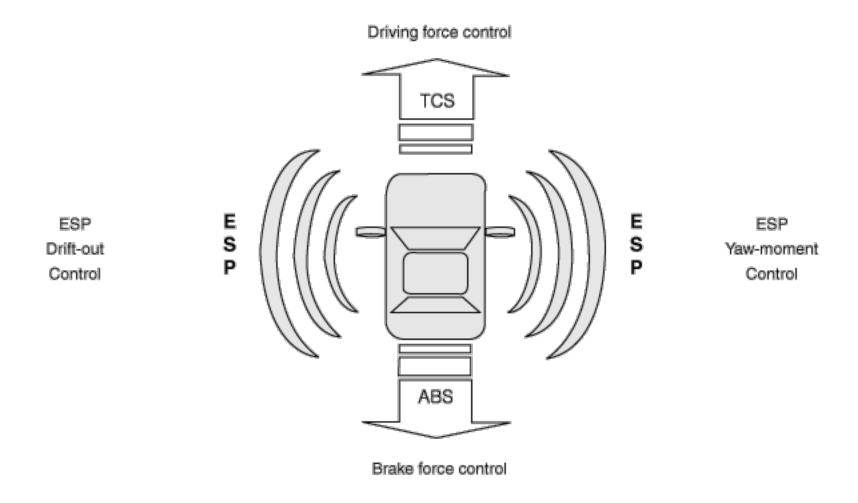
ESP adds a further function known as Active Yaw Control (AYC) to the ABS, TCS, EBD and EDC functions. Whereas the ABS/TCS function controls wheel slip during braking and acceleration and, thus, mainly intervenes in the longitudinal dynamics of the vehicle, active yaw control stabilizes the vehicle about its vertical axis.

This is achieved by wheel individual brake intervention and adaptation of the momentary engine torque with no need for any action to be taken by the driver.

ESP essentially consists of three assemblies: the sensors, the electronic control unit and the actuators.

The stability control feature works under all driving and operating conditions. Under certain driving conditions, the ABS/TCS function can be activated simultaneously with the ESP function in response to a command by the driver.

In the event of a failure of the stability control function, the basic safety function, ABS, is still maintained.



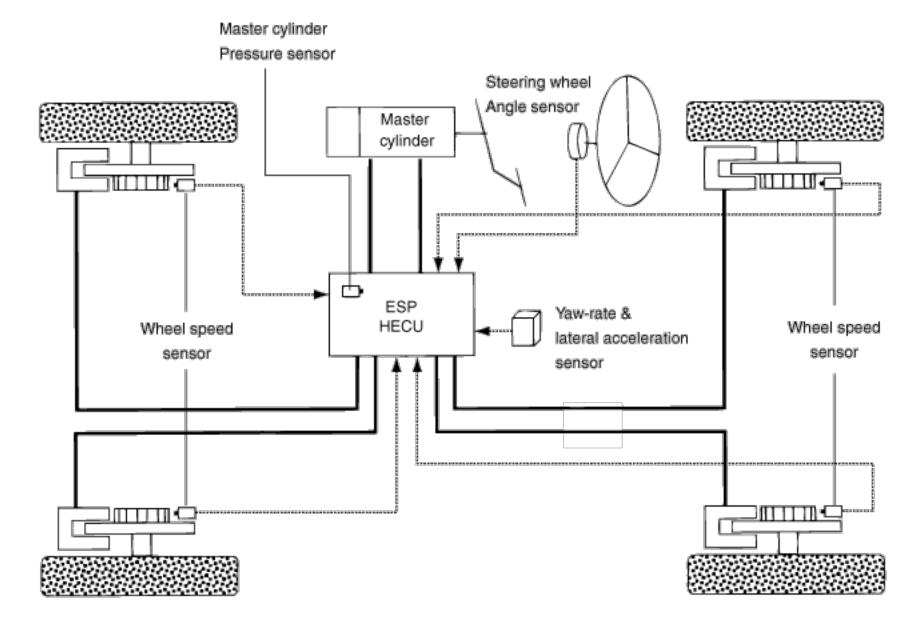
### Description of ESP control

ESP system includes ABS/EBD, TCS and AYC function.

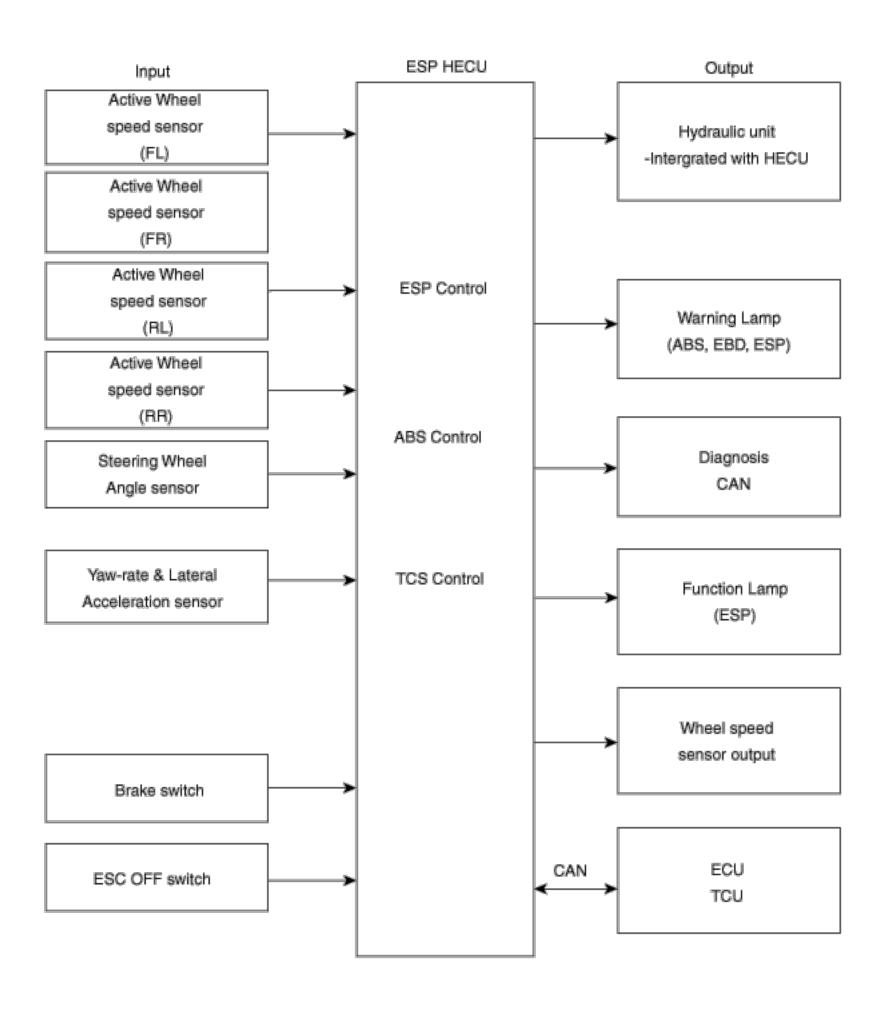
ABS/EBD function: The ECU changes the active sensor signal (current shift) coming from the four wheel sensors to the square wave. By using the input of above signals, the ECU calculates the vehicle speed and the acceleration & deceleration of the four wheels. and, the ECU judges whether the ABS/EBD should be actuated or not.

TCS function prevents the wheel slip of drive direction by adding the brake pressure and engine torque reduction via CAN communication. TCS function uses the wheel speed sensor signal to determine the wheel slip as far as ABS function.

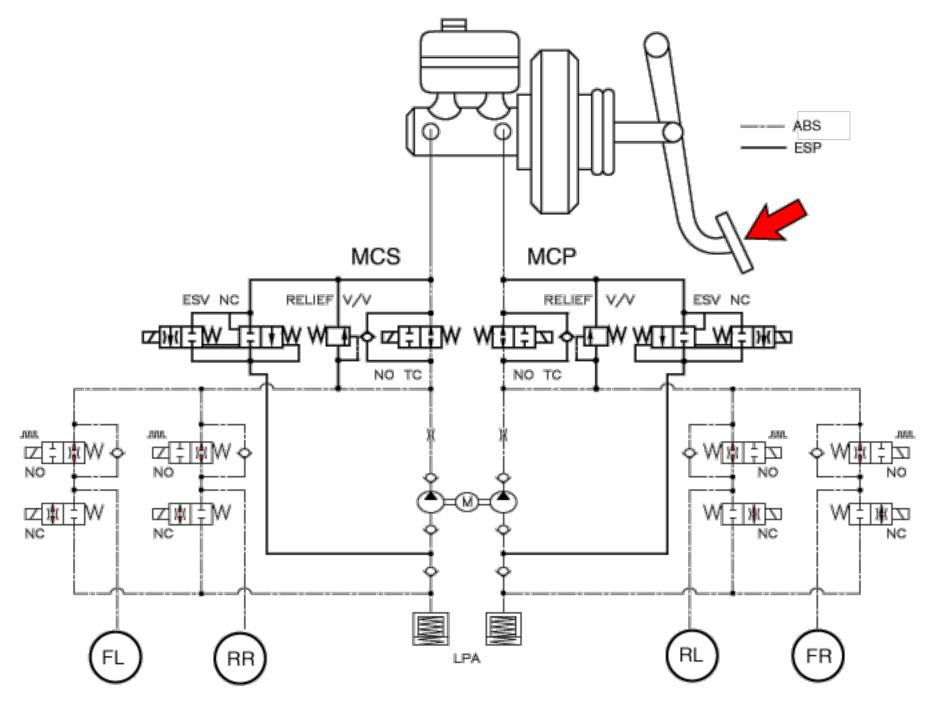
AYC function prevents unstable maneuver of the vehicle. To determine the vehicle maneuver, AYC function uses the maneuver sensor signals (Yaw Rate Sensor, Lateral Acceleration Sensor, Steering Wheel Angle Sensor). If vehicle maneuver is unstable (Over Steer or Under Steer), AYC function applies the brake pressure on certain wheel, and send engine torque reduction signal by CAN. After the key-on, the ECU continually diagnoses the system failure. (self-diagnosis) If the system failure is detected, the ECU informs driver of the system failure through the BRAKE/ABS/ESP warning lamp. (fail-safe warning)



Input and Output Diagram



## **ESP OPERATION MODE**

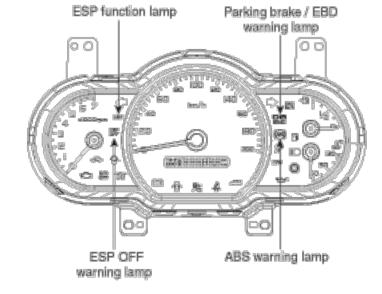


# 1. ESP Non-operation : Normal braking.

Solenoid valve	Continuity	Valve	Motor pump	TC Valve	
IN (NO)	OFF	OPEN	OFF	٥٢٢	
OUT (NC)	OFF	CLOSE	OFF OFF	OFF	

# 2. ESP operation

Solenoid valv	/e	Continuity	Valve	Motor pump	TC Valve
Understeering	IN(NO)	OFF	OPEN	ON	ON
(Only inside of rear wheel)	OUT(NC)	OFF	CLOSE		
Oversteering	IN(NO)	OFF	OPEN		
(Only outside of front wheel)	OUT(NC)	OFF	CLOSE		



### ABS Warning lamp module

The active ABS warning lamp module indicates the self-test and failure status of the ABS .The ABS warning lamp shall be on:

- During the initialization phase after IGN ON. (continuously 3 seconds).
- In the event of inhibition of ABS functions by failure.
- During diagnostic mode.
- When the ECU Connector is seperated from ECU.
- Cluster lamp is ON when communication is impossible with CAN module.

# EBD/Parking brake warning lamp module

The active EBD warning lamp module indicates the self-test and failure status of the EBD. However, in case the Parking Brake Switch is turned on, the EBD warning lamp is always turned on regardless of EBD functions. The EBD warning lamp shallbe on:

- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the Parking Brake Switch is ON or brake fluid level is low.
- When the EBD function is out of order.
- During diagnostic mode.
- When the ECU Connector is seperated from ECU.
- Cluster lamp is ON when communication is impossible with CAN module.

### **ESP Warning lamp (ESP System)**

The ESP warning lamp indicates the self-test and failure status of the ESP.

The ESP warning lamp is turned on under the following conditions:

- During the initialization phase after IGN ON. (continuously 3 seconds).
- In the event of inhibition of ESP functions by failure.
- When driver trun off the ESP function by on/off switch.
- During diagnostic mode.

### **ESP Function lamp (ESP System)**

The ESP function lamp indicates the self-test and operating status of the ESP.

The ESP Function lamp operates under the following conditions:

- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the ESP control is operating. (Blinking 2Hz)

# ESP On/Off switch (ESP System)

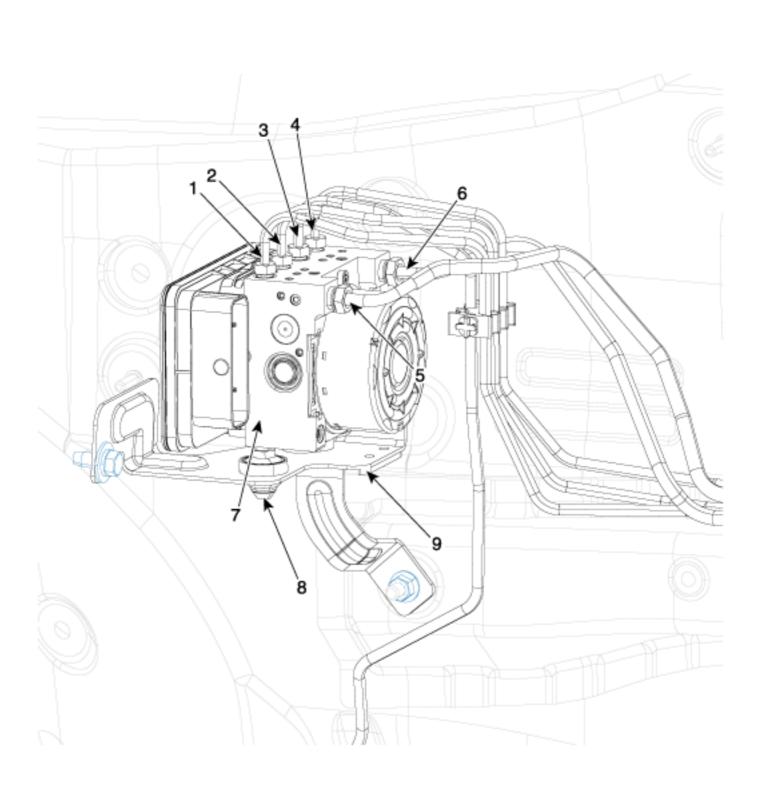
The ESP On/Off Switch shall be used to toggle the ESP function between On/Off states based upon driver input.

The On/Off switch shall be a normally open, momentary contact switch. Closed contacts switch the circuit to ignition.

Initial status of the ESP function is on and switch toggle the state.

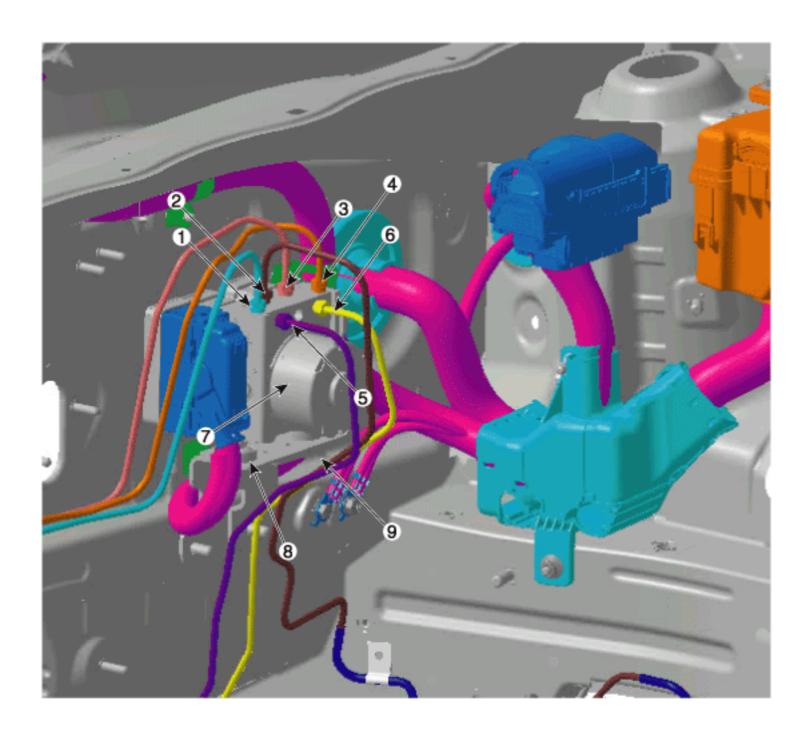
# **COMPONENTS**

[LHD]



- 1. Rear-right tube
- 2. Front-left tube
- 3. Front-right tube
- 4. Rear-left tube
- 5. MC1

- 6. MC2
- 7. ESP control module (HECU)
- 8. Damper
- 9. Bracket



- 1. Rear-right tube
- 2. Front-left tube
- 3. Front-right tube
- 4. Rear-left tube
- 5. MC1

- 6. MC2
- 7. ESP control module (HECU)
- 8. Damper
- 9. Bracket

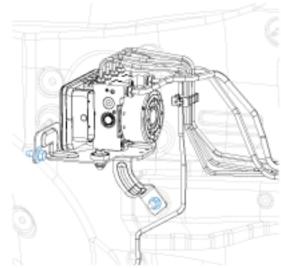
## **REMOVAL**

- 1. Turn the ignition switch OFF.
- 2. Pull up the lock of the ABS control unit connector, then disconnect the connector.
- 3. Disconnect the brake tubes from the HECU by unlocking the nuts counterclockwise with a spanner.

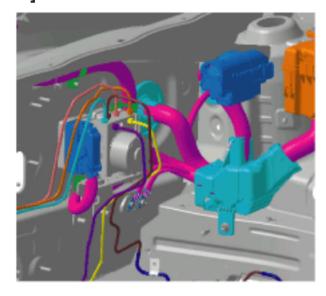
#### **Tightening torque:**

12.7 ~ 16.7 N.m (1.3 ~ 1.7 kgf.m, 9.4 ~ 12.3 lb-ft)

### [LHD]



### [RHD]

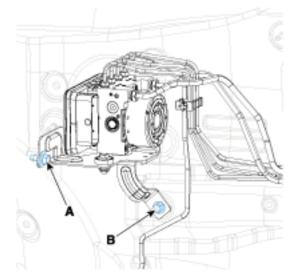


4. Loosen the ABS HECU bracket bolt (A) and nuts (B) then remove HECU and bracket.

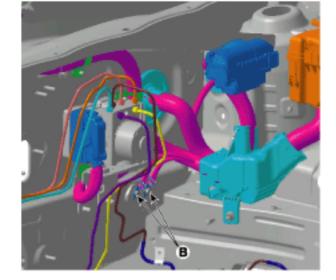
### **Tightening torque**

HECU mounting bolt (LHD) :  $16.7 \sim 25.5$  N.m ( $1.7 \sim 2.6$  kgf.m,  $12.3 \sim 18.8$  lb-ft) HECU mounting bolt (RHD) :  $19.6 \sim 29.4$  N.m ( $2.0 \sim 3.0$  kgf.m,  $14.5 \sim 21.7$  lb-ft) HECU mounting nut (RHD) :  $17.6 \sim 25.5$  N.m ( $1.8 \sim 2.6$  kgf.m,  $13.0 \sim 18.8$  lb-ft)

### [LHD]



[RHD]



5. Remove the bracket bolts, then remove the bracket from HECU.

# NOTICE

- 1) Never attempt to disassemble the HECU.
- 2) The HECU must be transported and stored in.
- 3) Never shock to the HECU.

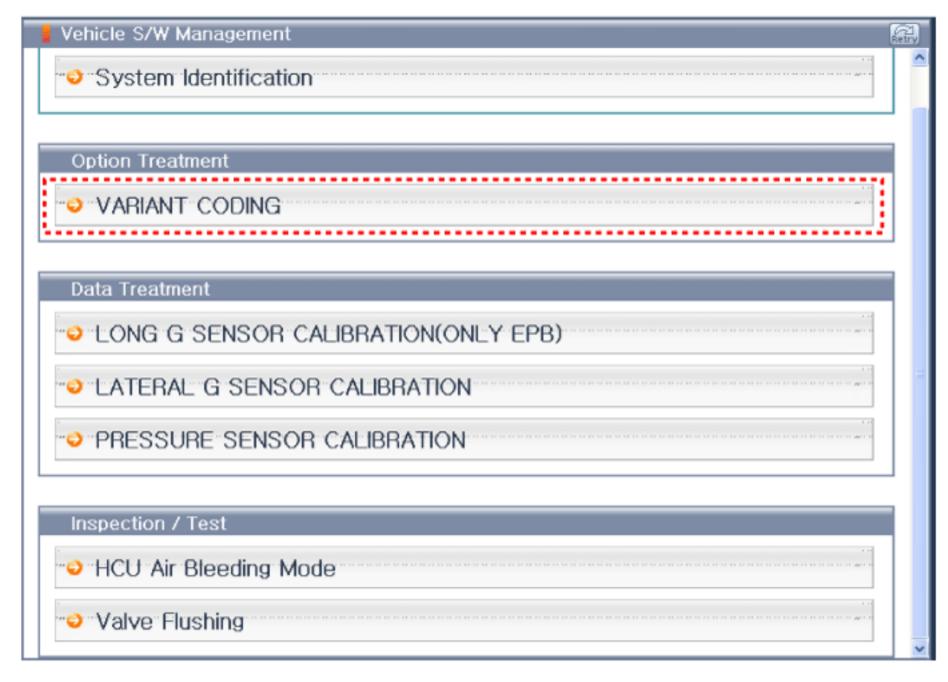
### **INSTALLATION**

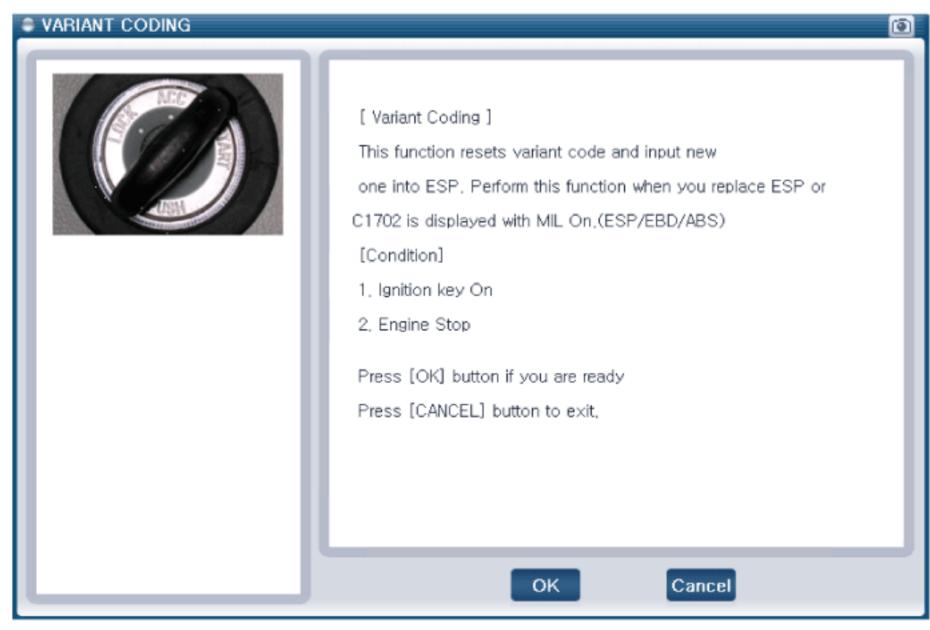
- 1. Installation is the reverse of removal.
- Perform the ABS bleeding.
   (Refer to Brake System "ABS Bleeding of Brake System")
- 3. Connect the GDS to the data link connector located underneath the dash panel.
- 4. Select and operate according to the instructions on the GDS screen.

## NOTICE

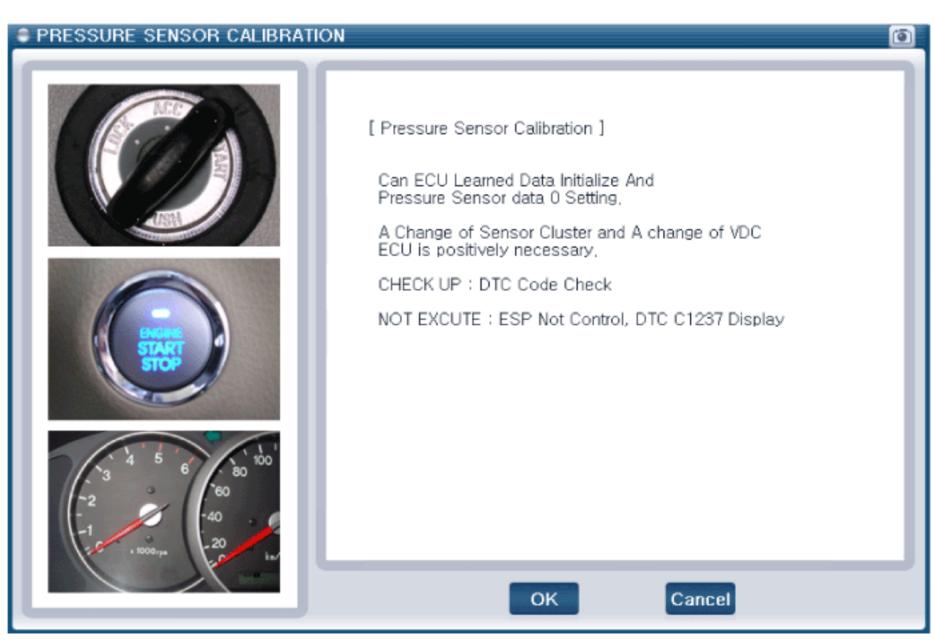
You must obey the maximum operating time of the ABS motor with the GDS to prevent the motor pump from burning.

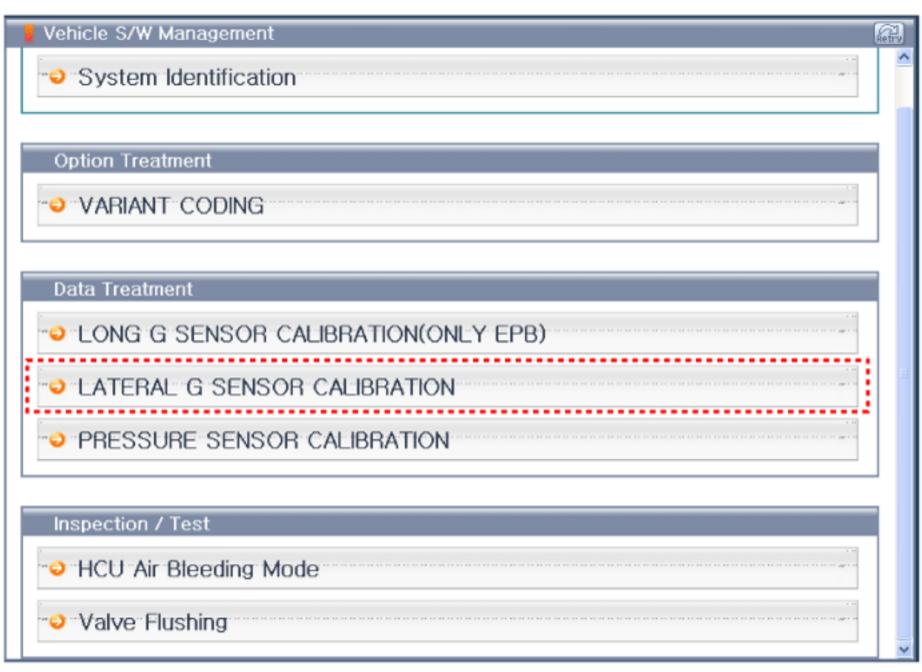
- 1) Select vehicle name.
- 2) Select Variant Coding.

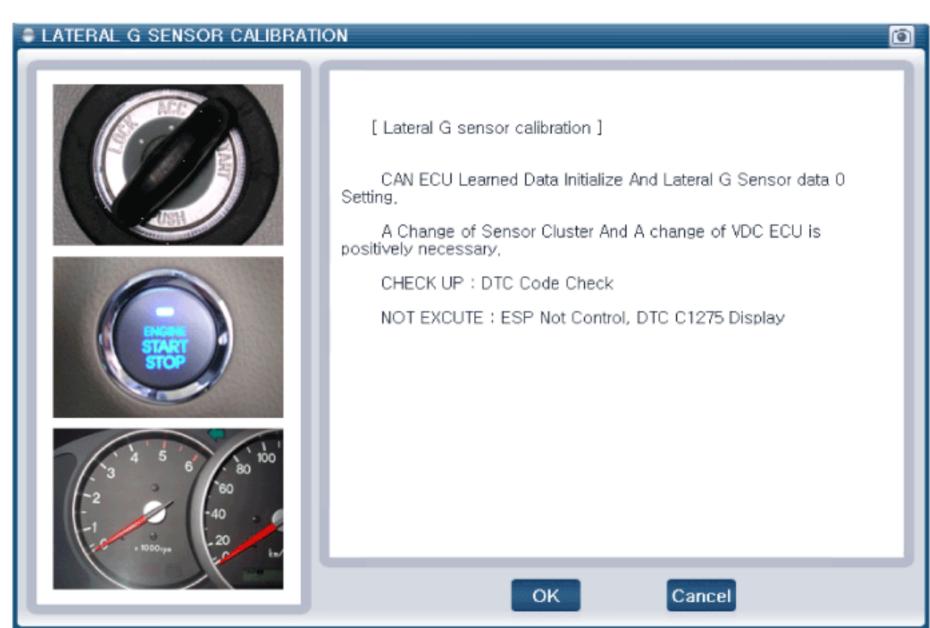










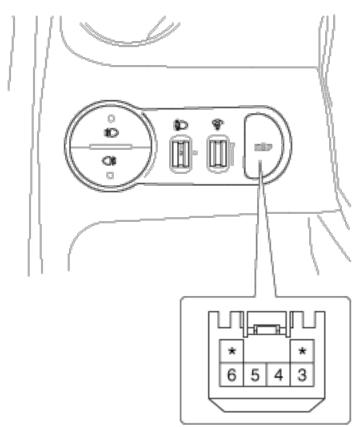


# **DESCRIPTION**

- 1. The ESP OFF switch is for the user to turn off the ESP system.
- 2. The ESP OFF lamp is on when ESP OFF switch is engaged.

# **INSPECTION**

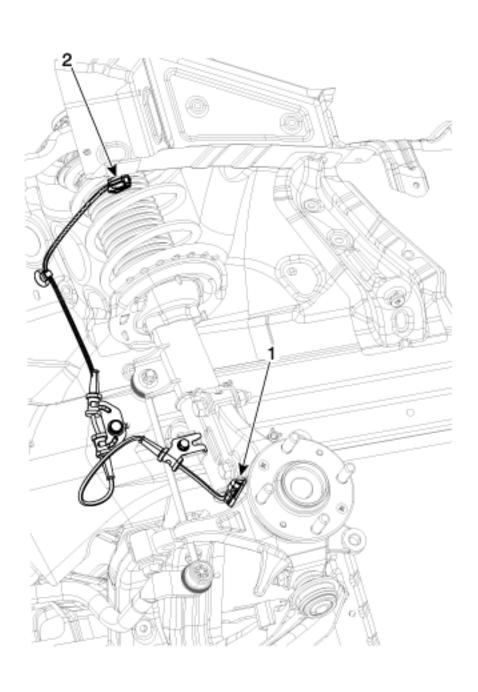
1. Remove the ESP OFF switch from the switch panel.



2. Check the continuity between the switch terminals as the ESP OFF switch is engaged.

Terminal Function	4	5	3	6
ON	0-	-0	P	P
OFF				

# **COMPONENTS**



1. Front wheel speed sensor

2. Front wheel speed sensor connector

#### **REMOVAL**

1. Remove the front wheel and tire.

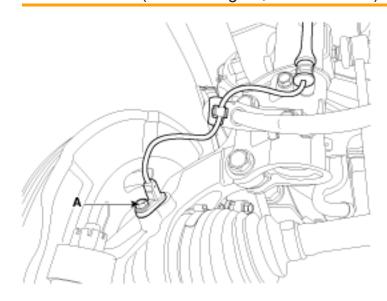
#### **Tightening torque:**

88.3 ~ 107.9 N.m (9.0 ~ 11.0 kgf.m, 65.1 ~ 79.6 lb-ft)

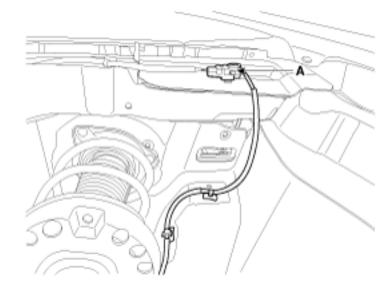
2. Remove the front wheel speed sensor mounting bolt (A).

#### Tightening torque:

 $6.9 \sim 10.8 \text{ N.m} (0.7 \sim 1.1 \text{ kgf.m}, 5.1 \sim 8.0 \text{ lb-ft})$ 



- 3. Remove the front wheel guard .
- 4. Disconnect the front wheel speed sensor connector (A), and then remove the front wheel speed sensor.



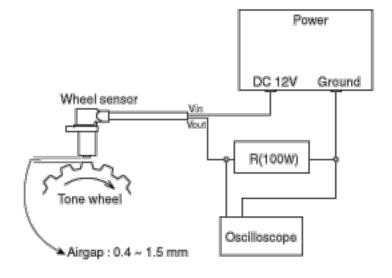
5. Install in the reverse order of removal.

### **INSPECTION**

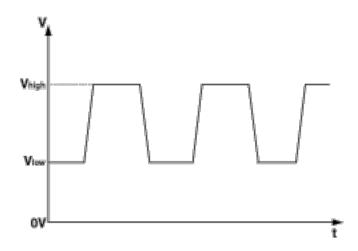
1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

### NOTICE

In order to protect the wheel speed sensor, when measuring output voltage, a  $100\Omega$  resister must be used as shown.



2. Compare the change of the output voltage of the wheel speed sensor to the normal change of the output voltage as shown below.

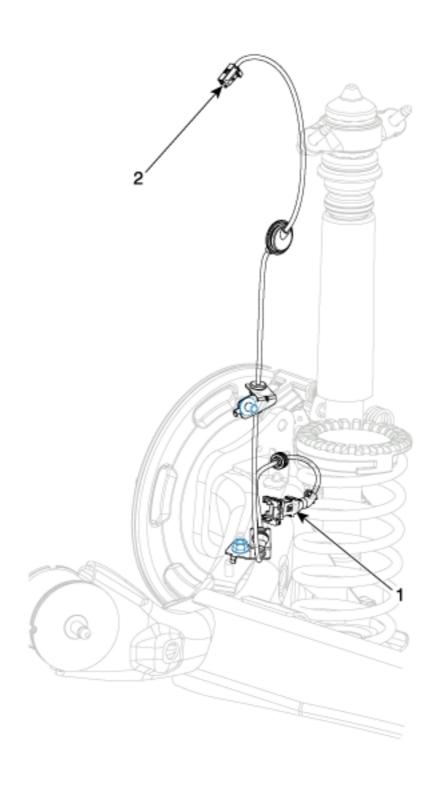


• V\_low: 0.59V ~ 0.84V

• V\_high : 0.18V ~ 1.68V

• Frequency range :  $1 \sim 2,500 \text{ Hz}$ 

# **COMPONENTS**



1. Rear wheel speed sensor

2. Rear wheel speed sensor connector

#### **REMOVAL**

1. Remove the rear wheel and tire.

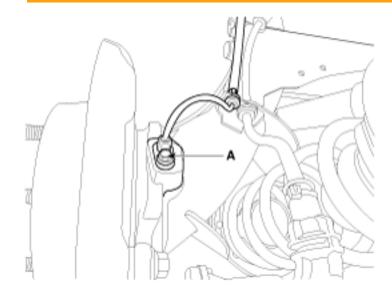
#### **Tightening torque:**

88.3 ~ 107.9 N.m (9.0 ~ 11.0 kgf.m, 65.1 ~ 79.6 lb-ft)

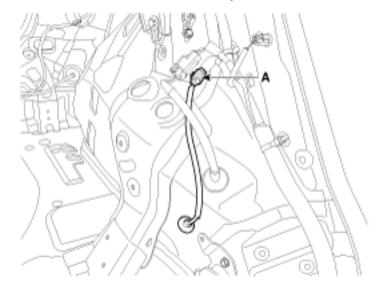
2. Remove the rear wheel speed sensor mounting bolt (A).

#### Tightening torque:

 $6.9 \sim 10.8 \text{ N.m} (0.7 \sim 1.1 \text{ kgf.m}, 5.1 \sim 8.0 \text{ lb-ft})$ 



- 3. Remove the rear wheel speed sensor cable mounting bolt.
- Remove the rear wheel house trim. (Refer to Body - "Rear Wheel House Trim")
- 5. Disconnect the rear wheel speed sensor connector (A), and than remove the rear wheel speed sensor.



6. Install in the reverse order of removal.

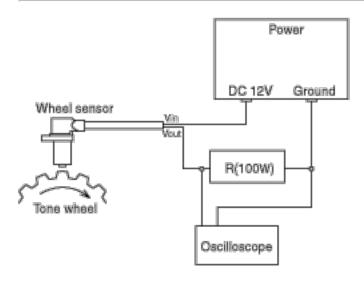
### NOTICE

Install the rear sensor after lubricating the O-ring of sensor with the assembly fluid (RAREMAX AF-1) When inserting the sensor, take care the O-ring not to be damaged.

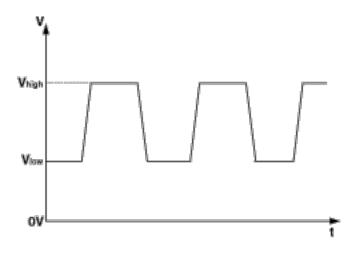
1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

# NOTICE

In order to protect the wheel speed sensor, when measuring output voltage, a  $100\Omega$  resistor must be used as shown.



2. Compare the change of the output voltage of the wheel speed sensor to the normal change of the output voltage as shown below.



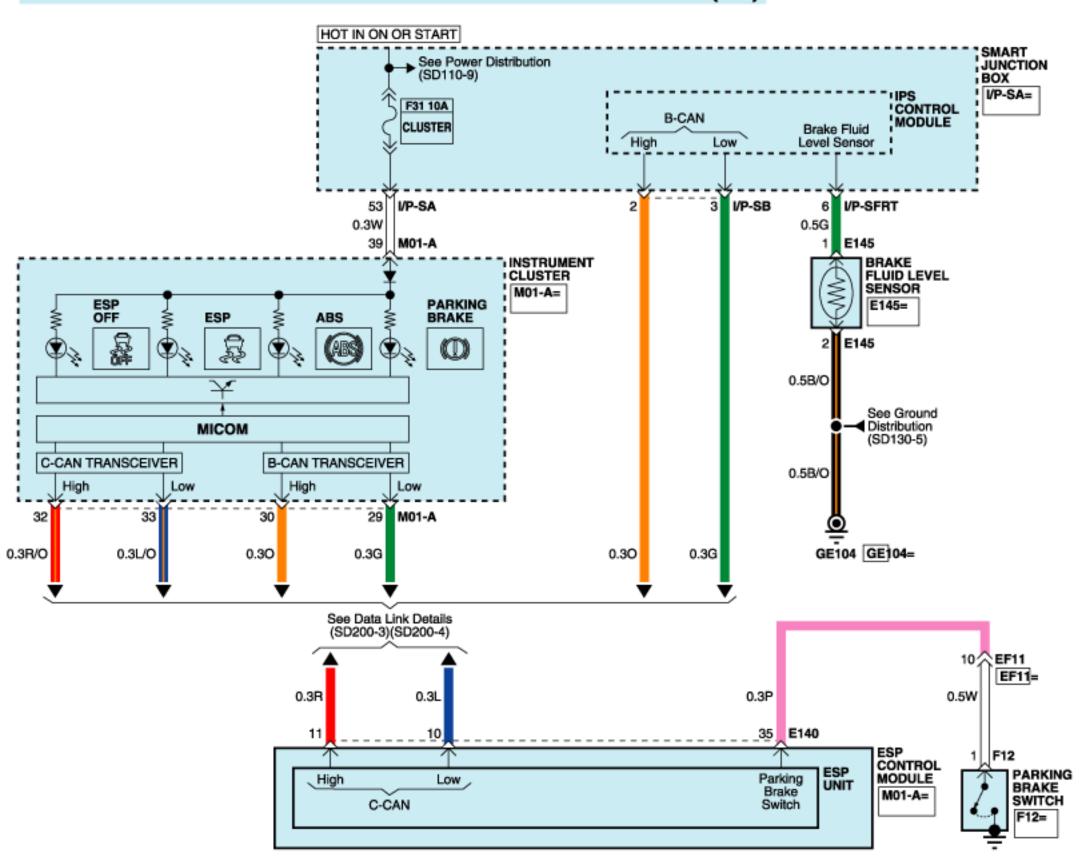
• V\_low: 0.59 V ~ 0.84 V

• V\_high : 1.18 V ~ 1.68 V

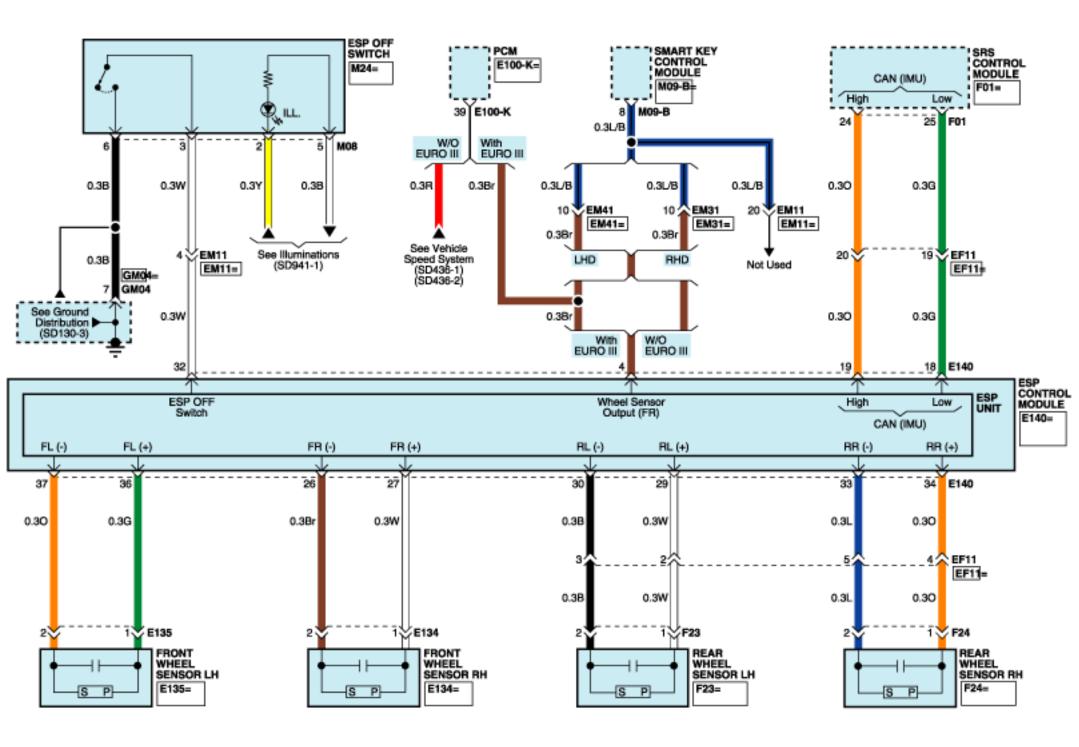
• Frequency range : 1  $\sim$  2,500 Hz

### **CIRCUIT DIAGRAM**

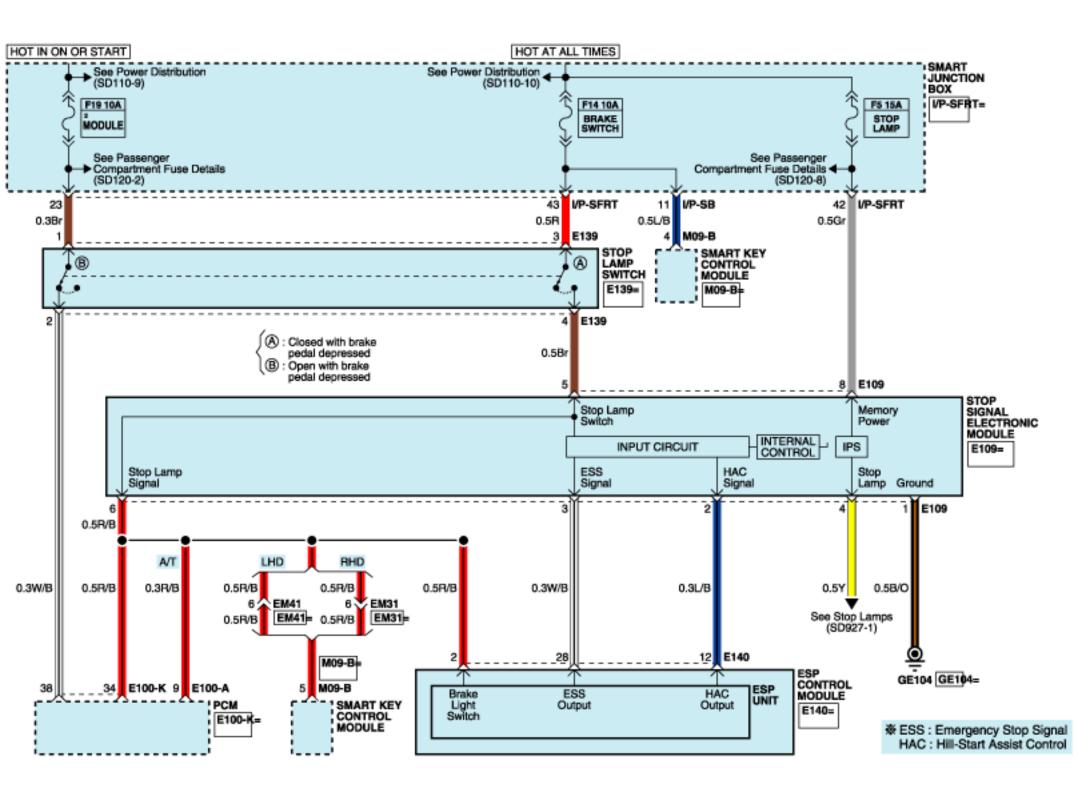
# With TACU/BCM - G3LA/G4LA : KAPPA 1.0L/1.2L/1.25L MPI (1/4)



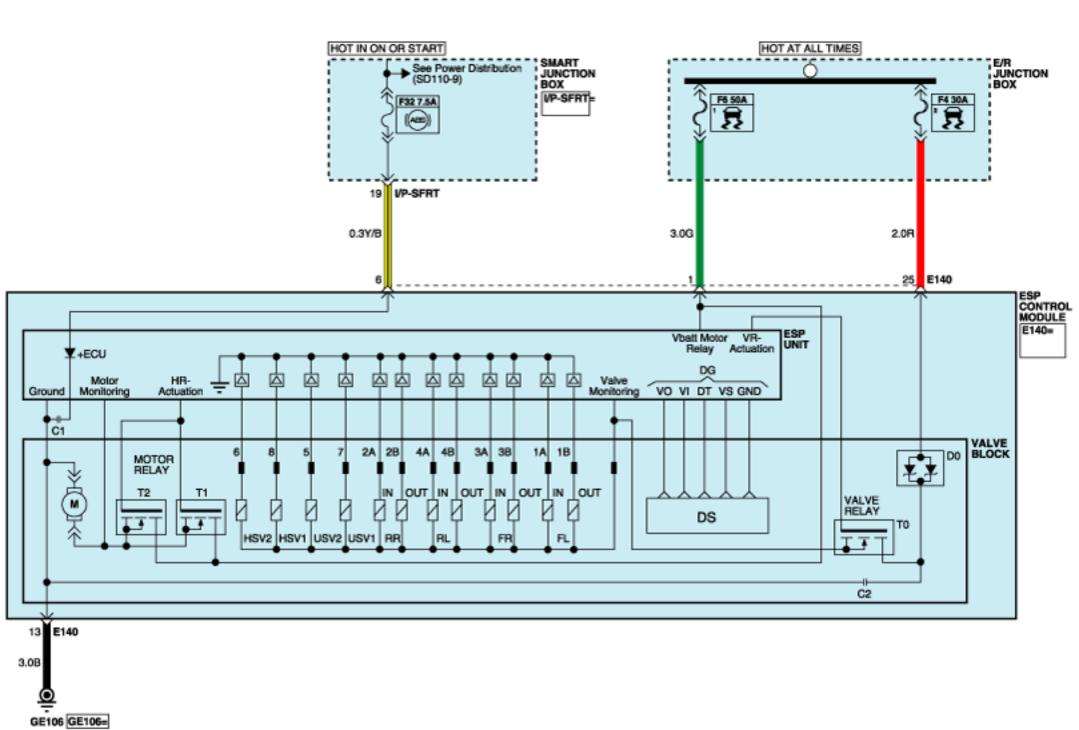
### With TACU/BCM - G3LA/G4LA : KAPPA 1.0L/1.2L/1.25L MPI (2/4)



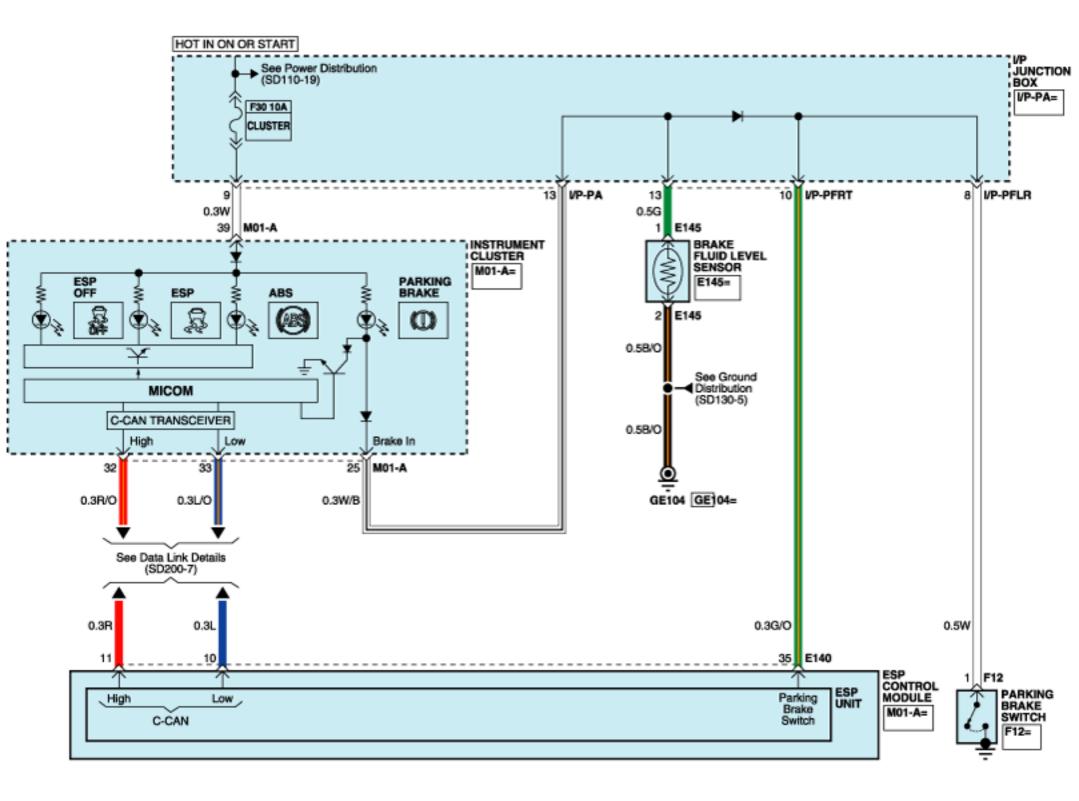
# With TACU/BCM - G3LA/G4LA: KAPPA 1.0L/1.2L/1.25L MPI (3/4)



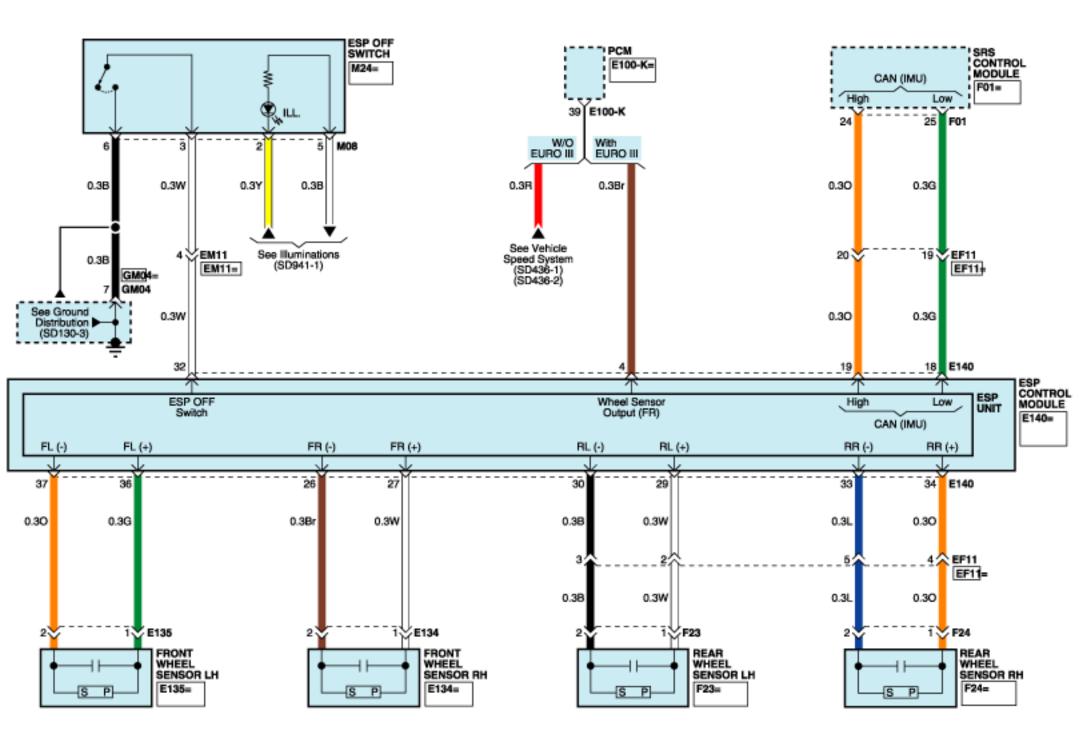
# With TACU/BCM - G3LA/G4LA : KAPPA 1.0L/1.2L/1.25L MPI (4/4)



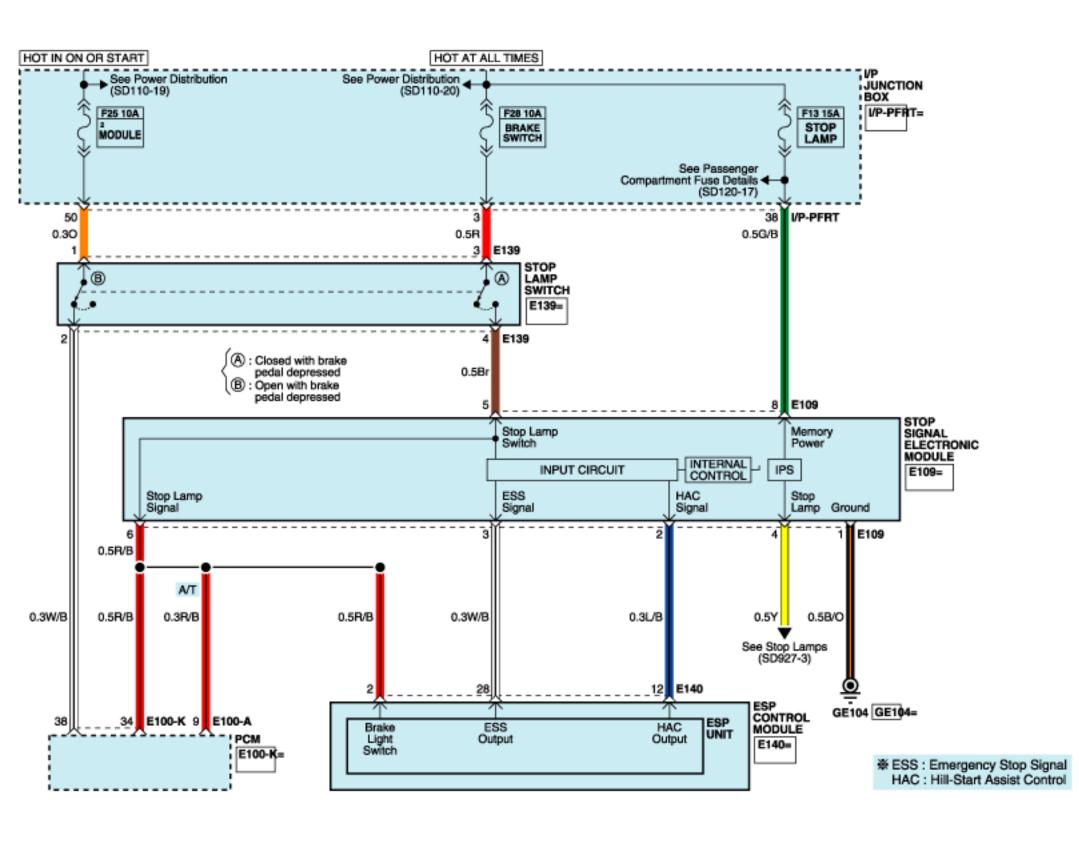
# W/O TACU & BCM - G3LA/G4LA : KAPPA 1.0L/1.2L/1.25L MPI (1/4)



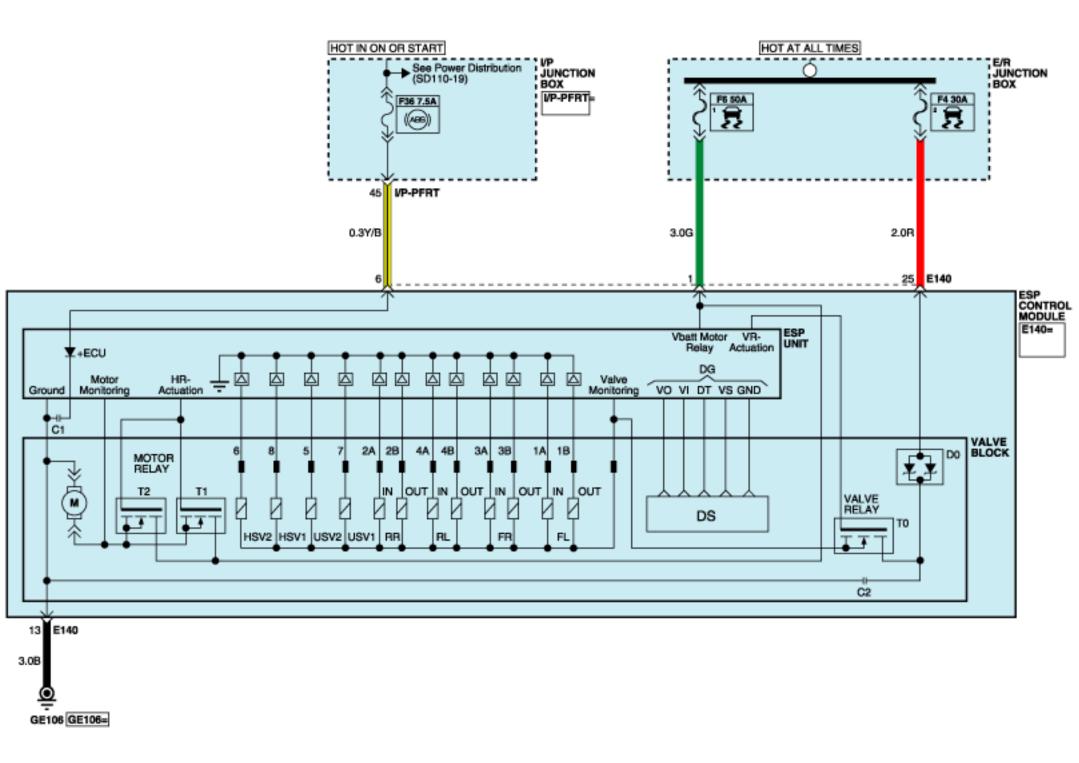
# W/O TACU & BCM - G3LA/G4LA : KAPPA 1.0L/1.2L/1.25L MPI (2/4)



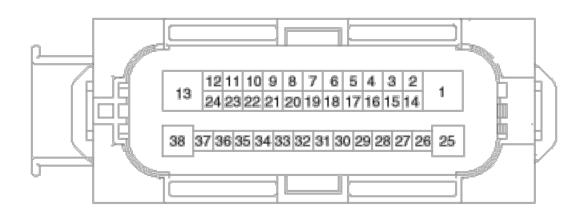
# W/O TACU & BCM - G3LA/G4LA : KAPPA 1.0L/1.2L/1.25L MPI (3/4)



### W/O TACU & BCM - G3LA/G4LA : KAPPA 1.0L/1.2L/1.25L MPI (4/4)



### **ESP CONNECTOR INPUT/OUTPUT**



Connector Terminal		Specification
No	Description	Specification
29	IGNITION1 (+)	High level of wake up voltage :4.5V < V < 16.0V Low level of wake up voltage : V < 2.4V Nominal current : I < 50 mA
		Over voltage range : 17.0 ± 0.5V

25	POS. BATTERY 1. (SOLENOID)	Operating voltage range : $10.0 \pm 0.5 \text{V} < \text{V} < 16.0 \pm 0.5 \text{V}$ Low voltage range : $7.0 \pm 0.5 \text{V} < \text{V} < 9.5 \pm 0.5 \text{V}$ Nominal current : $I < 40 \text{A}$ Max. leakage current : $I < 0.25 \text{ mA}$		
1	POS. BATTERY 2. (MOTOR)	Operating voltage range: 10.0 ± 0.5V < V < 16.0 ± 0.5V  Peak current : I < 110A  Nominal current : I < 40A  Max. leakage current : I < 0.25 mA		
38	GROUND	Rated current : I < 550mA Nominal current: I < 40A		
13	PUMP MOTOR GROUND	Peak current : I < 110A Nominal current : I < 40A		
4	SENSOR POWER	Max voltage : V_BAT1-0.8V Max current Capability : I < 250 mA		
11	SENSOR GROUND	Rated current : I <250 mA		
18	SENSOR FRONT LEFT POWER			
34	SENSOR FRONT RIGHT POWER	Output voltage : V_BAT1-0.6V ~ V_BAT1-1.1V		
19	SENSOR REAR LEFT POWER	Output current : Max. 30 mA		
33	SENSOR REAR RIGHT POWER			
31	SENSOR FRONT LEFT SIGNAL	In part or the old to		
21	SENSOR FRONT RIGHT SIGNAL	Input current LOW: 5.9 ~ 8.4 mA Input current HIGH: 11.8 ~ 16.8 mA		
32	SENSOR REAR LEFT SIGNAL	Frequency range :1 ~ 2,500 Hz		
20	SENSOR REAR RIGHT SIGNAL	Input duty : 50 ± 10%		
23	BRAKE LIGHT SWITCH	Input voltage (Low) : V < 2V		
10	ESP ON/OFF SWITCH	Input voltage (High): V > 6V		
9	BRAKE SWITCH	Max. input current:I < 3 mA (12.8V)		
22	PARKING BRAKE SWITCH	Input voltage (Low) : V < 2V Input voltage (High) : V > 6V Max input current : I < 5 mA (12.8V)		
28	SENSOR FRONT RIGHT OUTPUT	External pull up resistance : 1 K $\Omega$ < R Output duty : 50 ± 20%		
14	CAN BUS LINE(LOW)			
26	CAN BUS LINE(HIGH)	May input compant to 40 and		
12	CAN SENSOR LINE (HIGH)	Max. input current : I < 10 mA		
24	CAN SENSOR LINE (LOW)			
15	STEERING ANGLE SENSOR PHASE A	Input duty (STG A, STG B): 50 ± 10 %		
16	STEERING ANGLE SENSOR PHASE B	Phase Difference (STG A, STG B) : 2 ± 0.6 deg  High voltage : 3.0 V < VH < 4.1 V		
27	STEERING ANGLE SENSOR PHASE Z	I ow voltage: 1.3 V < VI < 2.0 V		

Low voltage : 1.3 V < VL < 2.0 V  $\,$ 

STEERING ANGLE SENSOR PHASE Z

27

2016 > G 1.2 MPI > G 1.2 MPI > Brake System > ESP(Electronic Stability Program) System > Steering Angle Sensor > Description and Operation

### **DESCRIPTION**

#### **General Data**

The Steering Angle Sensor (SAS) is installed in EPS (Electric Power Steering) and it sends messages to HECU through CAN communication line.

- The SAS is used to determine turning direction and speed of the steering wheel.
- The HECU uses the signals from the SAS when performing ESP-related calculations.
- Components (Steering Angle Sensor, Torque Sensor, Failsafe relay, etc.) of the EPS system are located inside the steering column & EPS unit assembly and the steering column & EPS unit assembly must not be disassemble to inspect or replace them. (Refer to steering system group)

### **FAILURE DIAGNOSIS**

- 1. In principle, ESP and TCS controls are prohibited in case of ABS failure.
- 2. When ESP or TCS fails, only the failed system control is prohibited.
- 3. However, when the solenoid valve relay should be turned off in case of ESP failure, refer to the ABS fail-safe.
- 4. Information on ABS fail-safe is identical to the fail-safe in systems where ESP is not installed.

### Memory of Fail Code

- 1. It keeps the code as far as the backup lamp power is connected. (O)
- 2. It keeps the code as far as the HCU power is on. (X)

### Failure Checkup

- 1. Initial checkup is performed immediately after the HECU power on.
- 2. Valve relay checkup is performed immediately after the IG2 ON.
- 3. It executes the checkup all the time while the IG2 power is on.

#### Countermeasures In Fail

- 1. Turn the system down and perform the following actions and wait for HECU power OFF.
- 2. Turn the valve relay off.
- 3. Stop the control during the operation and do not execute any until the normal condition recovers.

### Warning Lamp ON

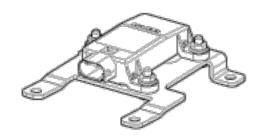
- 1. ESP operation lamp turn on for 3sec after IGN ON.
- 2. ESP operation lamp blinks when ESP Act.
- 3. ESP OFF warning lamp turn on in case of
  - ESP Switch OFF
  - ESP Failure Detect
  - 3sec after IGN ON

### **DESCRIPTION**

When the vehicle is turning with respect to a vertical axis the yaw rate sensor detects the yaw rate electroniclly by the vibration change of plate fork inside the yaw rate sensor.

If yaw velocity reaches the specific velocity after it detects the vehicle' yawing, the ESP control is reactivated.

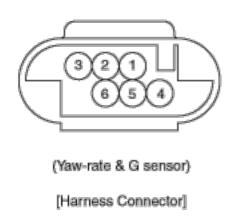
The later G sensor senses vehicle's lateral G. A small element inside the sensor is attached to a deflectable leverarm by later G. Direction and magnitude of lateral G loaded to vehicle can be known with electrostatic capacity changing according to lateral G. The sensor is located in the front passenger seat lower floor on vehicle.

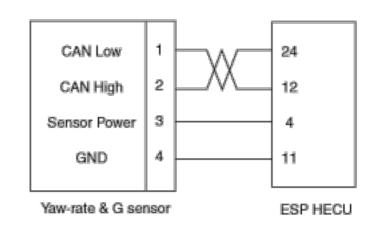


### **Specifications**

Descr	iption	Specification	Remarks
Operatin	Operating voltage		
Current consumption		Max. 140 mA	
Operating temperature		-40 ~ 85°C	
Yaw-rate sensor	Measurement range	-75 ~ 75°/sec	
raw-rate serisor	Frequency response	15 ~ 45 Hz	
Lateral Cappaer	Measurement range	-14.715 ~ +14.715 m/s <sup>2</sup>	
Lateral G sensor	Frequency response	50 Hz ± 60%	

# **External Diagram**



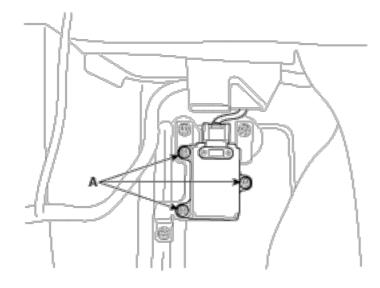


### **REMOVAL**

- 1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
- 2. Remove the passenger seat assembly. (Refer to Body "Seat")
- 3. Disconnect the yaw rate & lateral G sensor connector.
- 4. Remove the mounting bolts (A).

### **Tightening torque:**

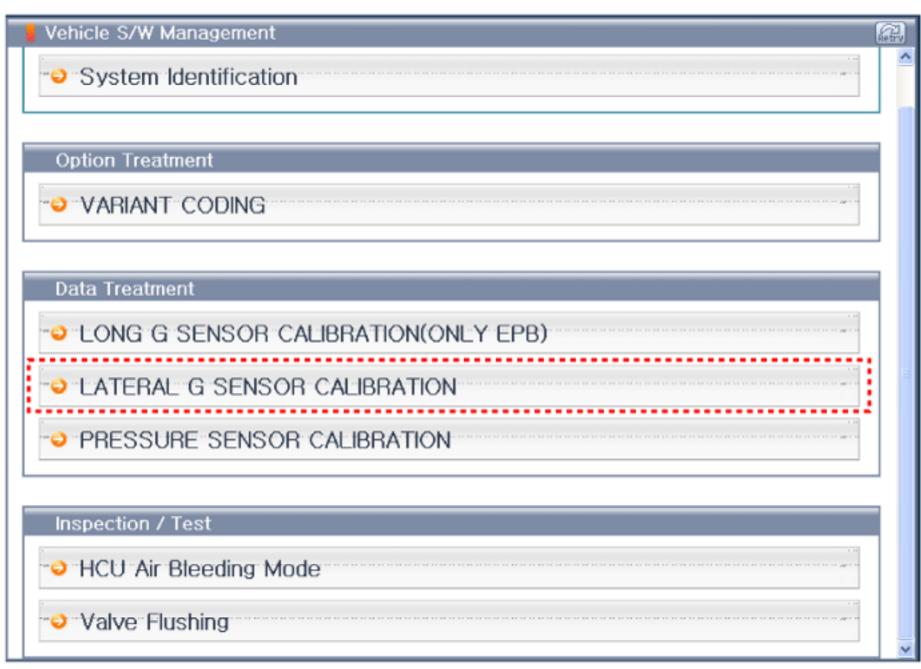
7.9 ~ 10.8 N.m (0.8 ~ 1.1 kgf.m, 5.8 ~ 8.0 lb-ft)

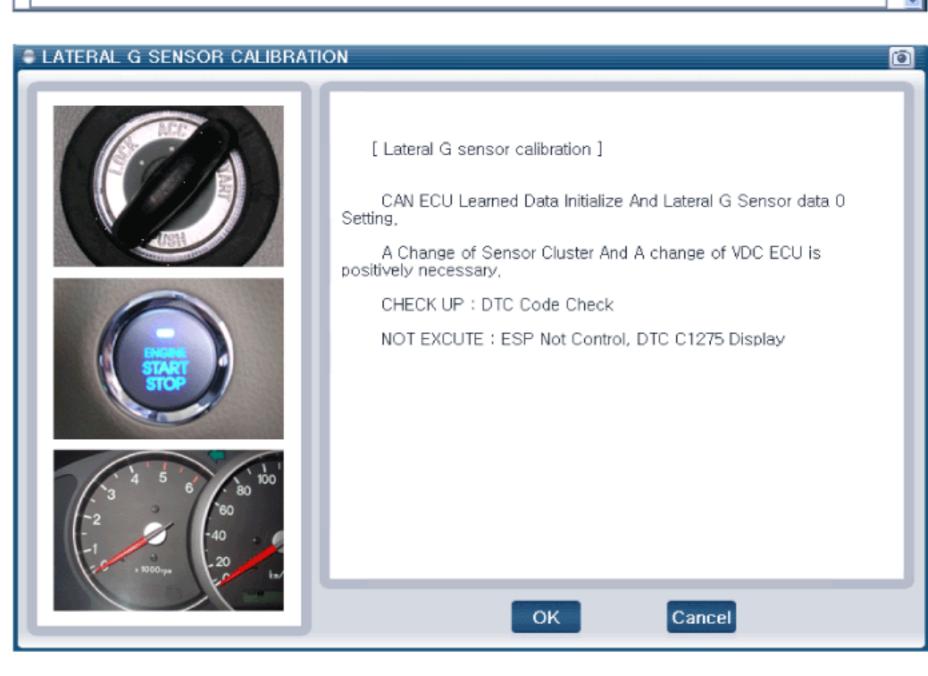


5. Installation is the reverse of removal.

### **G-SENSOR CALIBRATION**

- 1. Ignition "OFF", connect GDS.
- 2. Ignition "ON" & Engine "OFF" select vehicle name and ESP system.
- 3. Perform G-sensor calibration.





4. Complete the "G-Sensor Calibration" procedure.

# **SPECIAL SERVICE TOOLS**

Tool (Number and Name)	Illustration	Use
09581 - 11000 Piston expander		Pushing back of the front disc and rear disc brake piston
09580-0U000 Brake piston adjuster		Removal and installtion of the rear disc brake piston.

actuation

### **SPECIFICATIONS**

	Туре	Tandem			
Maa yidaMaa yida	Cylinder I.D.	20.64 mm (0.813 in)			
Mse yidrMse yidr	Piston stroke	33 ± 1 mm (1.30 ± 0.003	9 in)		
	Fluid level switch	Provided			
			F4FA (1.6L)		
Brake booster		F3LA (1.0L) With A/C	F3LA (1.0L) Without A/C		
	Туре	10" Single	9" Single		
	Boosting ratio	8:01	7.5:1		
		F4FA (1.6L)	F3LA (1.0L)		
	Туре	Ventilated disc	Ventilated disc		
Front Dioc broke	Disc O.D.	256 mm (10.08 in)	252 mm (9.92 in)		
Front Disc brake	Disc thickness	22 mm (0.87 in)	18 mm (0.709 in)		
	Caliper piston	Single	Single		
	Cylinder I.D.	Ø 54 mm (2.13 in)	Ø 54 mm (2.12 in)		
	Туре	Leading trailing			
Door broke (Drum)	Drum I.D	203.2 mm (8 in)			
Rear brake (Drum)	Brake lining thickness	4.5 mm (0.18 in)			
	Clearance adjustment	Automatic			
Darking broke	Туре	Mechanical brake acting	on rear wheels		
Parking brake	actuation	Lever	Lever		

Lever

Standard value

1 ~ 2500 Hz

Remark

# NOTICE

O.D.: Outer Diameter I.D: Inner Diameter

# Specification (ESP)

Part

Active Wheel speed sensor (ESP)

	System	4 Channel 4 Sensor (Solenoid)	
	Туре	Motor, valve relay intergrated type	
HECU	Operating Voltage	10 ~ 16V	
	Operating Temperature	-40 ~ 120°C (-40 ~ 248°F)	
	Motor power	270 W	
	Supply voltage	DC 4.5 ~ 20V	
	Output current low	5.9 ~ 8.4 mA	
A akiya Mila a laga a da a ga a gi (FOD)	Output current high	11.8 ~ 16.8 mA	

Item

Output range

Tone wheel	48 teeth	
Air gap	0.4 ~ 1.0 mm	

# Service Standard

Items	Standard value
Brake pedal height	177 mm (6.97 in)
Brake pedal Full stroke	108 mm (4.25 in)
Stop lamp clearance	1.0 ~ 2.0 mm (0.06 ~ 0.08 in)
Brake pedal free play	2 ~ 4 mm (0.08 ~ 0.16 in)
Front brake disc thickness	18 mm (0.70 in)
Front brake disc pad thickness	11 mm (0.43 in)

# Tightening Torques

ltem		Nm	kgf.m	lb-ft
Hub nut		88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Master cylinder to booster mounting n	ut	12.7 ~ 16.7	1.3 ~ 1.7	7.2 ~ 12.3
Brake booster mounting nut (RHD)		16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8
Brake booster mounting nut (LHD)		16.7 ~ 22.6	1.7 ~ 2.7	12.3 ~ 16.6
Bleeder screw		6.9 ~ 12.7	0.7 ~ 1.3	5.1 ~ 9.4
Brake tube to flare nuts		12.7 ~ 16.7	1.3 ~ 1.7	9.4 ~ 12.3
Caliper guide rod bolt		21.6 ~ 31.4	2.2 ~ 3.2	15.9 ~ 23.1
Caliper mounting bolt (Front)		78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Caliper mounting bolt (Rear)		63.7 ~ 73.5	6.5 ~ 7.5	47.0 ~ 54.2
Brake hose to caliper		24.5 ~ 29.4	2.5 ~ 3.0	18.1 ~ 21.7
Wheel speed sensor mounting bolt		8.8 ~ 13.7	0.9 ~ 1.4	6.5 ~ 10.1
HECU mounting bracket nut (LHD)		17.7~ 25.5	1.8 ~ 2.6	13.0 ~ 18.8
HECLI mounting brooket (PHD)	bolt	19.6 ~ 29.4	2.0 ~ 3.0	14.5 ~ 21.7
HECU mounting bracket (RHD)	nut	17.7~ 25.5	1.8 ~ 2.6	13.0 ~ 18.8
Yaw rate & Lateral G sensor mounting bolt		7.9 ~ 10.8	0.8 ~ 1.1	5.8 ~ 8.0

# **LUBRICANT**

Items	Recommended	Quantity
Brake fluid	DOT 3 or DOT 4	As required
Brake pedal bushing and bolt	Chassis grease	As required
Parking brake shoe and backing plate contacting surface	Heat resistance grease	As required
Bitmap Front caliper guide rod and boot	AI-11P	0.8 ~ 2.0 g

# **TROUBLESHOOTING**

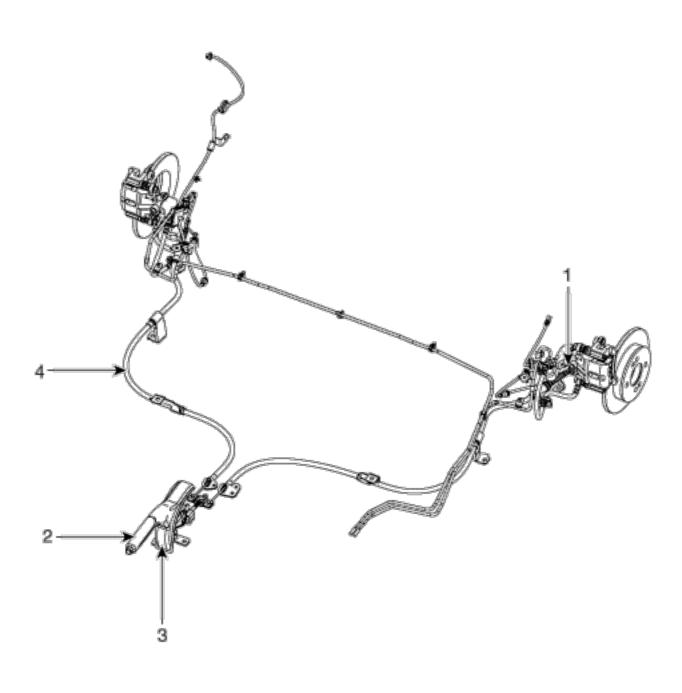
### **Problem Symptoms Table**

Use the table below to help you find the cause of theproblem. The numbers indicate the priority of the likecause of the problem. Check each part in order.

If necessary, replace these parts.				
Symptom	Suspect Area	Reference		
Lower pedal or spongy pedal	<ol> <li>Brake system (Fluid leaks)</li> <li>Brake system (Air in)</li> <li>Piston seals (Worn or damaged)</li> <li>Rear brake shoe clearance (Out of adjustment)</li> <li>Master cylinder (Inoperative)</li> </ol>	repair Air bleeding replace adjust replace		
Brake drag	<ol> <li>Brake pedal free play (Minimum)</li> <li>Parking brake lever travel (Out of adjustment)</li> <li>Parking brake wire (Sticking)</li> <li>Rear brake shoe clearance (Out of adjustment)</li> <li>Pad or lining (Cracked or distorted)</li> <li>Piston (Stuck)</li> <li>Piston (Frozen)</li> <li>Anchor or Return spring (Inoperative)</li> <li>Booster system (Vacuum leaks)</li> <li>Master cylinder (Inoperative)</li> </ol>	adjust adjust repair adjust replace replace replace replace replace replace replace		
Brake pull	<ol> <li>Piston (Sticking)</li> <li>Pad or lining (Oily)</li> <li>Piston (Frozen)</li> <li>Disc (Scored)</li> <li>Pad or lining (Cracked or distorted)</li> </ol>	replace replace replace replace replace		
Hard pedal but brake inefficient	<ol> <li>Brake system (Fluid leaks)</li> <li>Brake system (Air in)</li> <li>Pad or lining (Worn)</li> <li>Pad or lining (Cracked or distorted)</li> <li>Rear brake shoe clearance (Out of adjustment)</li> <li>Pad or lining (Oily)</li> <li>Pad or lining (Glazed)</li> <li>Disc (Scored)</li> <li>Booster system (Vacuum leaks)</li> </ol>	repair Air bleeding replace replace adjust replace replace replace replace replace		
Noise from brake	<ol> <li>Pad or lining (Cracked or distorted)</li> <li>Installation bolt (Loosen)</li> <li>Disc (Scored)</li> <li>Sliding pin (Worn)</li> <li>Pad or lining (Dirty)</li> <li>Pad or lining (Glazed)</li> <li>Anchor or Return spring (Faulty)</li> <li>Brake pad shim (Damage)</li> <li>Shoe hold-down spring (Damage)</li> </ol>	replace adjust replace replace clean replace replace replace replace replace		
Brake fades	1. master cylinder	replace		
Brake vibration, pulsation	brake booster     pedal free play     master cylinder	replace adjust replace		

	4. caliper	replace
	5. master cylinder cap seal	replace
	6. damaged brake lines	replace
Brake chatter	Brake chatter is usually caused by loose or worn components, or glazed or burnt linings. Rotors with hard spots can also contribute to brake chatter. Additional causes of chatter are out-of-tolerance rotors, brake lining not securely attached to the shoes, loose wheel bearings and contaminated brake lining.	

# **COMPONENT LOCATION**



- 1. Rear parking brake
- 2. Parking brake lever

- 3. Parking brake switch
- 4. Parking brake cable

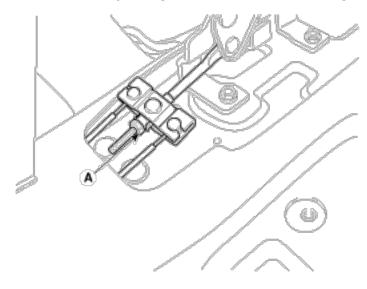
### **REMOVAL**

### NOTICE

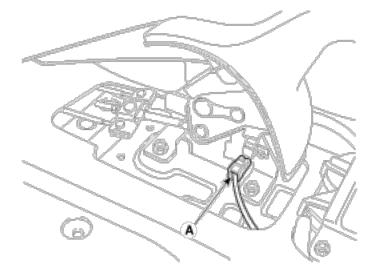
The parking brake cables must not be bent or distorted.

This will lead to stiff operation and premature failure.

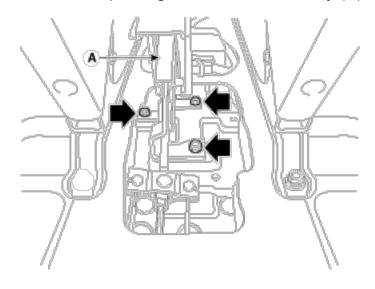
- 1. Remove the console.
- 2. Loosen the adjusting nut (A) and the parking brake cables.



3. Disconnect the connector (A) of parking brake switch.



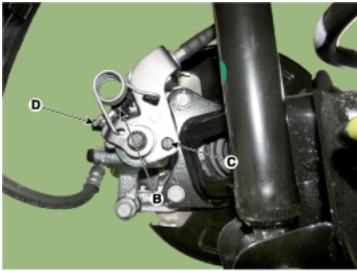
4. Remove the parking brake lever assembly (A).



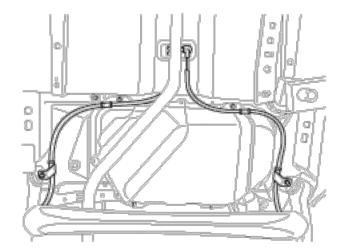
5. Remove the parking cable clip (A) from the parking brake cable (B).

6. Loosen the bolt (C) to discnnect the parking cable (B) from the lever (D).





7. Remove the clamps of parking brake cables and then remove the parking brake cables.



### **INSTALLATION**

- 1. Install the removed parts in the reverse order of removal.
- 2. Apply a coating of the specified grease to each sliding parts of the ratchet plate or the ratchet pawl.

### **Specified grease:**

Multi purpose grease SAE J310, NLGI No.2

3. After installing the cable adjuster, adjust the parking brake lever stroke (Refer to the parking brake check and adjustment).

### PARKING BRAKE CHECK AND ADJUSTMENT

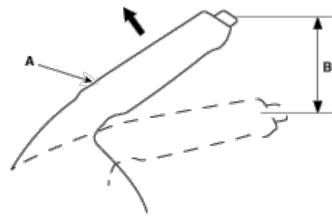
#### Inspection

1. Pull the parking brake lever (A) with 196 N (20 kg, 44lbf) force to fully apply the parking brake. The parking brake lever should be locked within the specified number of clicks (B).

#### Lever locked clicks

Vehicle with rear disc brakes: 7~8 Vehicle with rear drum brakes: 7

#### Pulled up with 196 N (20 kg, 44 lb)



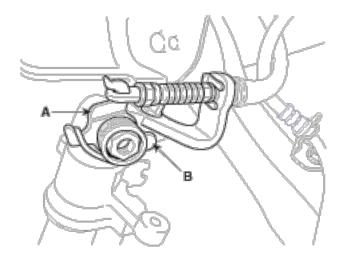
2. Adjust the parking brake if the lever clicks are out of specification.

### **ADJUSTMENT**

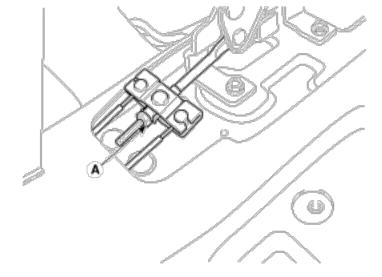
### **NOTICE**

After rear brake caliper servicing, loosen the parking brake adjusting nut, start the engine and depress the brake pedal several times to set the self-adjusting brake before adjusting the parking brake.

- 1. Block the front wheels, then raise the rear of the vehicle and make sure it is securely supported.
- 2. Make sure the parking brake arm (A) on the rear brake caliper contacts the brake caliper pin (B).

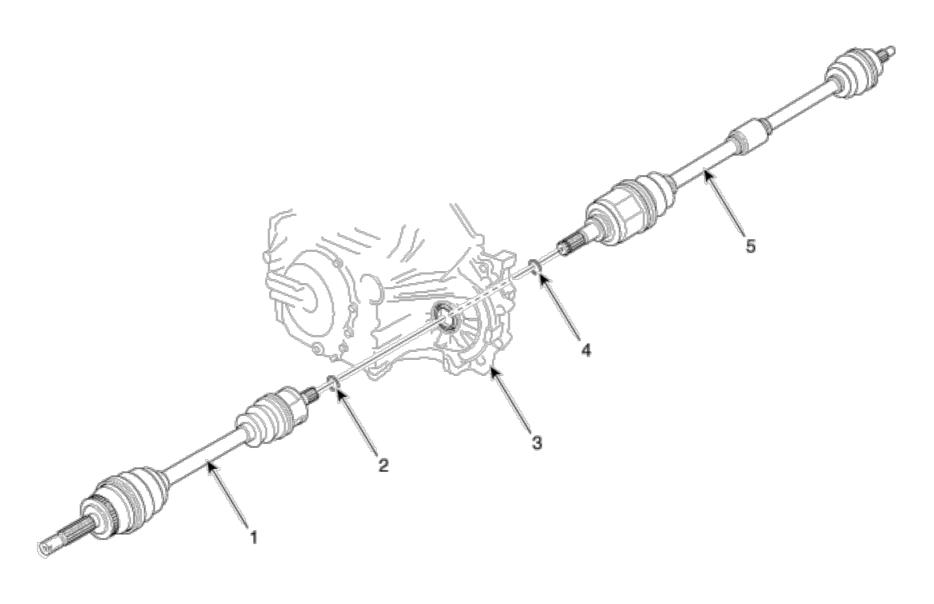


- 3. Pull the parking brake lever up one click.
- Remove the floor console.
   (Refer to Body "Floor Console")
- 5. Tighten the adjusting nut (A) until the parking brakes drag slightly when the rear wheels are turned.



- 6. Release the parking brake lever fully, and check that parking brakes do not drag when the rear wheels are turned. Readjust if necessary.
- 7. Make sure that the parking brakes are fully applied when the parking brake lever is pulled up fully.
- 8. Reinstall the console.

### **COMPONENTS LOCATION**

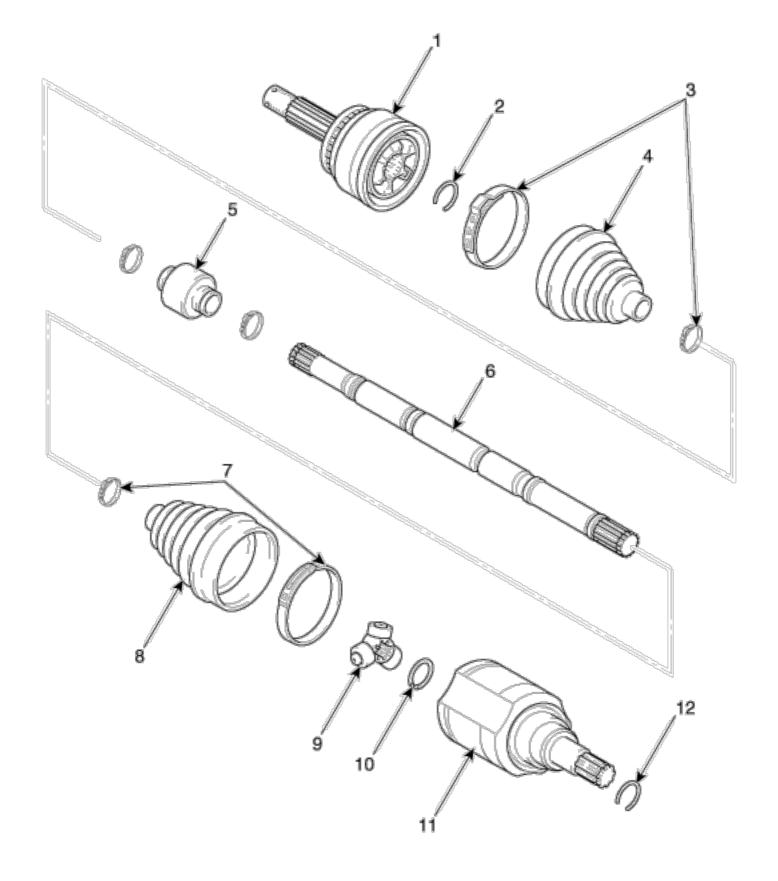


1.	Driveshaft	(	H)	
	Direction	<b>└</b>	,	

- 2. Circlip
- 3. Transaxle

- 4. Circlip
- 5. Driveshaft (RH)

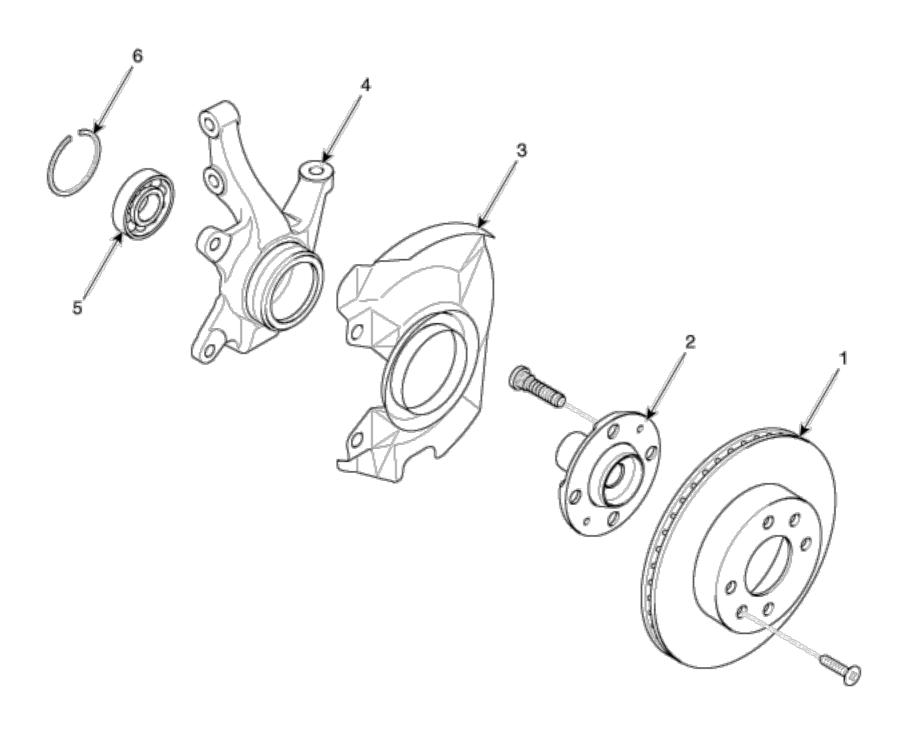
### **COMPONENTS**



- 1. Joint assembly (on wheel side)
- 2. Clip
- 3. Boot band
- 4. Boot
- 5. Dynamic damper
- 6. Shaft

- 7. Boot band
- 8. Boot
- 9. Spider assembly
- 10. Clip
- 11. Joint case (on transaxle side)
- 12. Circlip

# **COMPONENTS**



- 1. Brake disc
- 2. Hub assembly
- 3. Dust cover

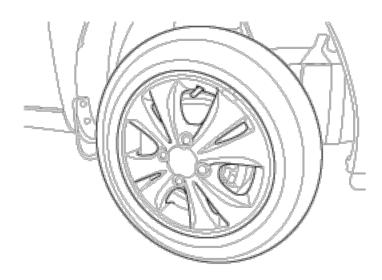
- 4. Knuckle assembly
- 5. Hub bearing
- 6. Snap ring

### **REPLACEMENT**

1. Remove the front wheel & tire.

### Tightening torque:

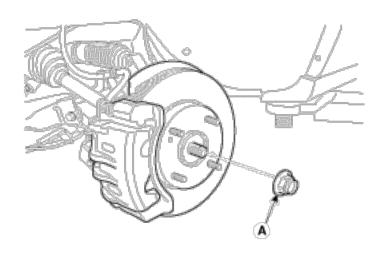
90.0 ~ 110.0 N.m (9.0 ~ 10.0 kgf.m, 65.0 ~ 80.0 lb-ft)



2. Loosen the driveshaft lock nut (A).

### Tightening torque:

245.0 ~ 275.0 N.m (24.5 ~ 27.5 kgf.m, 177.0 ~ 199.0 lb-ft)



3. Remove the wheel speed sensor from the knuckle.

### Tightening torque:

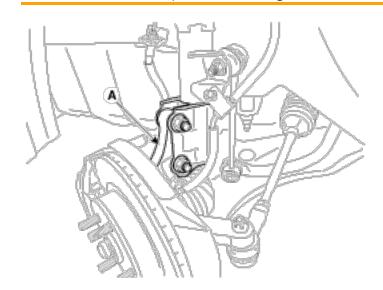
7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.8 ~ 8.7 lb-ft)



4. Disconnect the front strut assembly with the knuckle (A) by loosening the bolt & nut.

### Tightening torque:

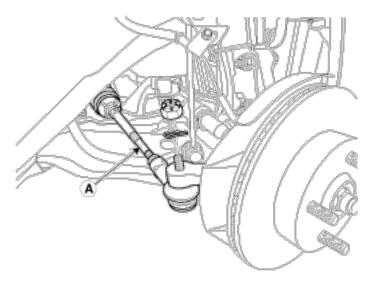
100.0 ~ 120.0 N.m (10.0 ~ 12.0 kgf.m, 72.0 ~ 87.0 lb-ft)



5. Remove the sprit pin and castle nut and then disconnect the tie-rod end (A) from the front knuckle.

### Tightening torque:

24.0 ~ 34.0 N.m (2.4 ~ 3.4 kgf.m, 17.0 ~ 25.0 lb-ft)





6. Remove the front caliper assembly (A) from the knuckle and then suspend it with wire.

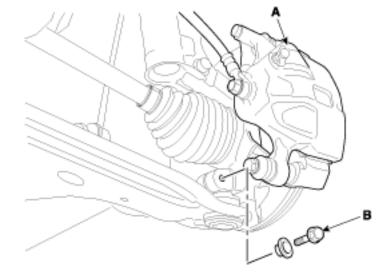
### Tightening torque:

80.0 ~ 100.0 N.m (8.0 ~ 10.0 kgf.m, 58.0 ~ 72.0 lb-ft)

7. Loosen the bolt (B) and then remove the front knuckle & hub assembly from the lower arm.

### **Tightening torque:**

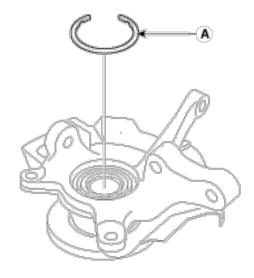
60.0 ~ 72.0 N.m (6.0 ~ 7.2 kgf.m, 43.0 ~ 52.0 lb-ft)



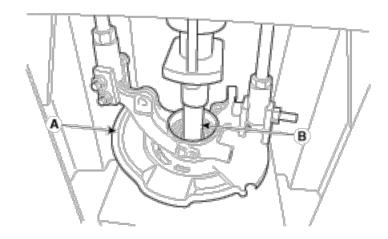
8. Installation is the reverse of the removal.

### **DISASSEMBLY**

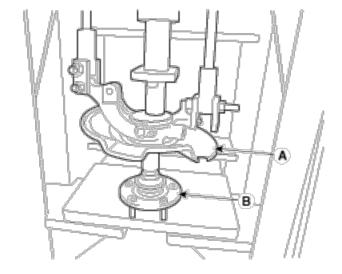
1. Remove the snap ring (A).



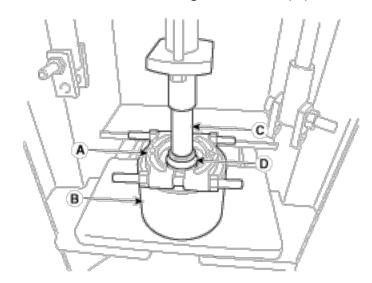
- 2. Remove the hub assembly from the knuckle assembly.
  - (1) Install the front knuckle assembly (A) on press.
  - (2) Lay a suitable adapter (B) upon the hub assembly shaft.



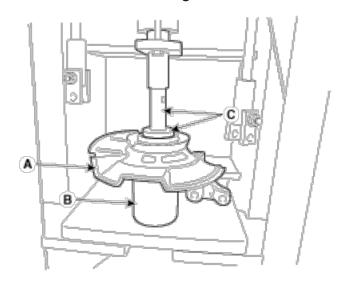
(3) Remove the hub assembly (B) from the knuckle assembly (A) by using press.



- 3. Remove the hub bearing inner race from the hub assembly.
  - (1) Install a suitable tool (A) for removing the hub bearing inner race on the hub assembly.
  - (2) Lay the hub assembly and tool (A) upon a suitable adapter (B).
  - (3) Lay a suitable adapter (C) upon the hub assembly shaft.
  - (4) Remove the hub bearing inner race (D) from the hub assembly by using press.



- 4. Remove the hub bearing outer race from the knuckle assembly.
  - (1) Lay the hub assembly (A) upon a suitable adapter (B).
  - (2) Lay a suitable adapter (C) upon the hub bearing outer race.
  - (3) Remove the hub bearing outer race from the knuckle assembly by using press.



5. Replace hub bearing with a new one.

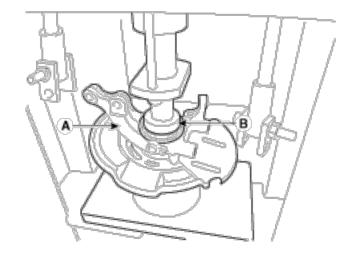
- 1. Check the hub for cracks and the splines for wear.
- 2. Check the brake disc for scoring and damage.
- 3. Check the knuckle for cracks.
- 4. Check the bearing for cracks or damage.

#### REASSEMBLY

- 1. Install the hub bearing to the knuckle assembly.
  - (1) Lay the knuckle assembly (A) on press.
  - (2) Lay a new hub bearing upon the knuckle assembly (A).
  - (3) Lay a suitable adapter (B) upon the hub bearing.
  - (4) Install the hub bearing to the knuckle assembly by using press.

### NOTICE

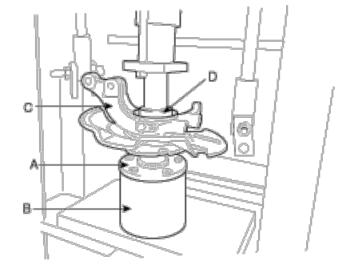
- Do not press against the inner race of the hub bearing because that can cause damage to the bearing assembly.
- · Always use a new wheel bearing assembly.



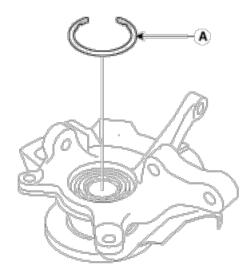
- 2. Install the hub assembly to the knuckle assembly.
  - (1) Lay the hub assembly (A) upon a suitable adapter (B).
  - (2) Lay the knuckle assembly (C) upon the hub assembly (A).
  - (3) Lay a suitable adapter (D) upon the hub bearing.
  - (4) Install the hub assembly (A) to the knuckle assembly (C) by using press.

### **NOTICE**

 Do not press against the inner race of the hub bearing because that can cause damage to the bearing assembly.



# 3. Install the snap ring (A).



2016 > G 1.2 MPI > G 1.2 MPI > Driveshaft and axle > Rear Axle Assembly > Rear Hub - Carrier > Components and Components Location

# **COMPONENTS**



1. Dust cover

2. Hub bearing assembly

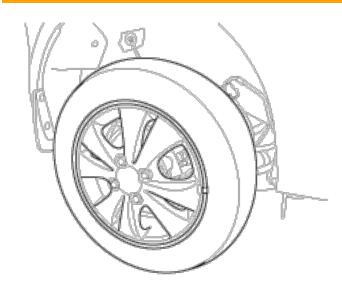
3. Brake disc

### REPLACEMENT

1. Remove the rear wheel & tire.

### Tightening torque:

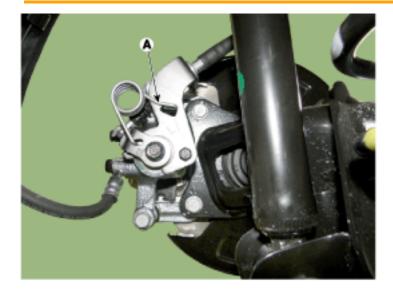
90 ~ 110 N.m (9.0 ~ 11.0 kgf.m, 65 ~ 80 lb-ft)



2. Remove the rear caliper assembly (A) and then suspend it with wire.

### Tightening torque:

50~60 N.m (5.0~6.0 kgf.m, 36~43 lb-ft)



3. disconnector wheel speed sensor connector (A). (ABS only)



4. Remove the rear hub & carrier assembly by loosen the mounting bolts.





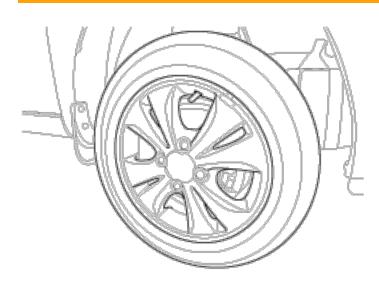
5. Installation is the reverse of the removal

### **REPLACEMENT**

1. Remove the front wheel & tire.

### Tightening torque:

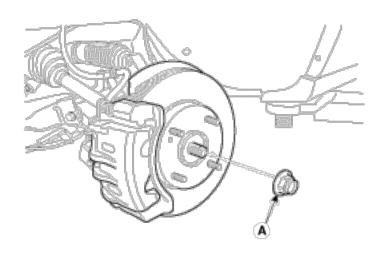
90.0 ~ 110.0 N.m (9.0 ~ 10.0 kgf.m, 65.0 ~ 80.0 lb-ft)



2. Loosen the driveshaft lock nut (A).

### Tightening torque:

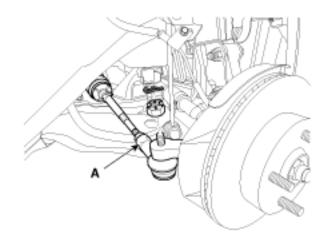
245.0 ~ 275.0 N.m (24.5 ~ 27.5 kgf.m, 177.0 ~ 199.0 lb-ft)



3. Remove the sprit pin, castle nut and then disconnect the tie rod end (A) from the knuckle.

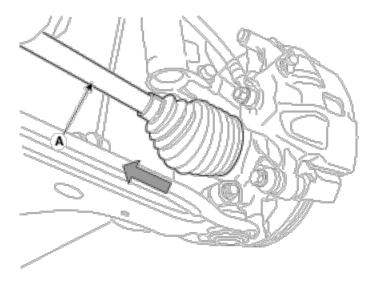
### Tightening torque:

24.0 ~ 34.0 N.m (2.4 ~ 3.4 kgf.m, 17.0 ~ 25.0 lb-ft)

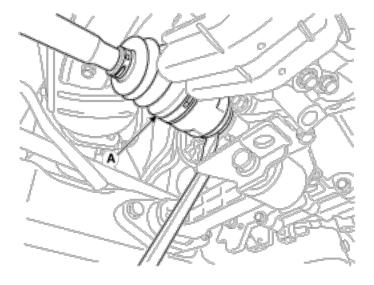




4. Separate the driveshaft (A) from the knuckle using a plastic hammer.



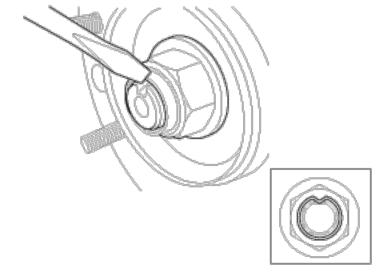
5. Separate the driveshaft from the transaxle case.



6. Installation is t he reverse of the removal.

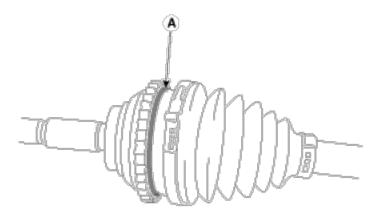
### NOTICE

- Before inserting the driveshaft to the transaxle case, apply gear oil on the oil seal contacting surface of the transaxle case and driveshaft spline. Set the opening side of the circlip facing downward.
- After installing the driveshaft to the transaxle case, be sure not to come out.
- The driveshaft lock nut should be replaced with new ones. After tightening the driveshaft lock nut, stake the lock nut using a chisel and hammer.

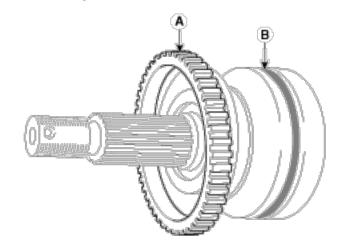


### Tone Wheel Replacement

- 1. Remove the driveshaft.
- 2. Matchmark (A) the driveshaft and remove the tone wheel from the driveshaft.



- 3. Clean the portion where new tone wheel is installed.
- 4. Heat a new tone wheel to 280~300°C for 10minutes and below using a hot plate or a heat gun. Do not heat it excessively over 350°C.
- 5. Put on the gloves and slide the heated tone wheel (A) to the machmark on the driveshaft.



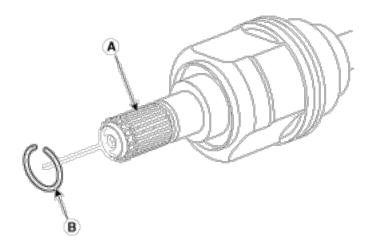
6. Wait for the new tone wheel cools down and then reinstall the driveshaft.

### **DISASSEMBLY**

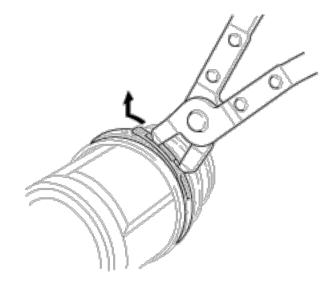
### NOTICE

• Do not disassemble the wheel side joint assembly.

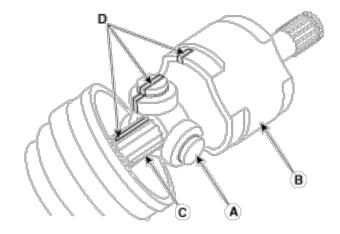
- Special grease must be applied to the driveshaft joint. Do not substitute with another type of grease.
- The boot band should be replaced with a new one.
- 1. Remove the circlip (B) from the driveshaft spline (A).



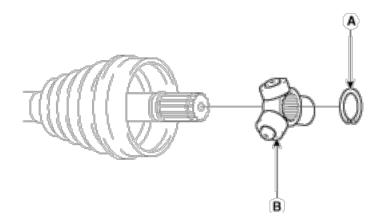
2. Remove both boot bands from the transaxle side joint case.



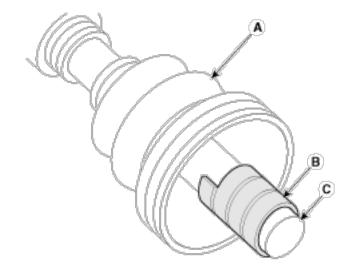
- 3. Pull out the boot from transaxle side joint case (B).
- 4. Make alignment marks on spider roller assembly (A), joint case (B), and shaft spline (C) to aid reassembly.



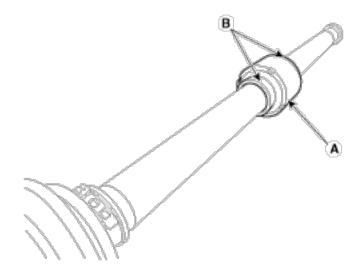
5. Remove the snap ring (A) and spider roller assembly (B) from the shaft.



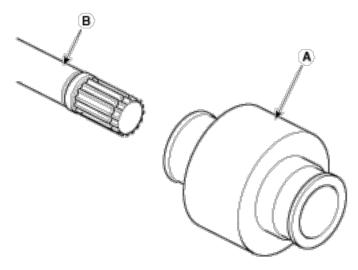
6. Wrap tape (B) around the driveshaft spline (C) to protect the boot, and then pull boot (A) from the shaft.



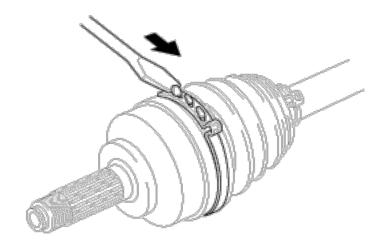
7. Remove the remove the both side of band (B) of the dynamic damper (A).



- 8. Fix the driveshaft (A) with a vice. Apply soap powder on the shaft to prevent the shaft spline and the dynamic damper when the dynamic damper is removed.
- 9. Separate dynamic damper (A) from the shaft (B) carefully.



10. Remove the both bands on the side of wheel.



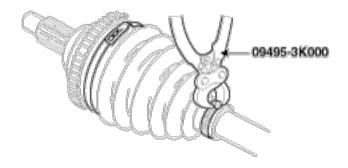
11. Pull out the joint boot on the side of wheel into the transaxle direction. Be careful not to damage the boot.

### **INSPECTION**

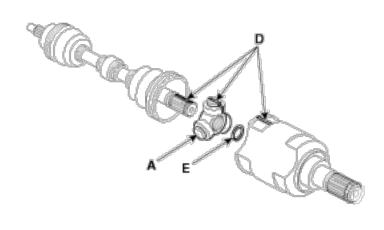
- 1. Check the driveshaft boots for damage and deterioration.
- 2. Check the driveshaft spline for wear or damage.
- 3. Check that there is no water or foreign material in the joint.
- 4. Check the spider assembly for roller rotation, wear or corrosion.
- 5. Check the groove inside the joint case for wear or corrosion.
- 6. Check the dynamic damper for damage or cracks.

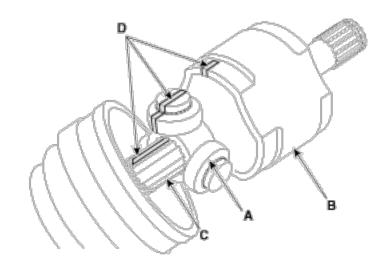
### **REASSEMBLY**

- 1. Wrap tape around the driveshaft spline to prevent damage to the boots.
- 2. Apply grease to the joint boot on the side of the wheel and install the boot.
- 3. Install the bands and then secure the bands by using a SST (09495-3K000).



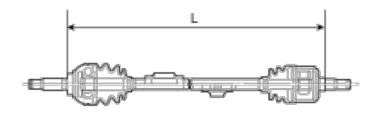
- 4. To install the dynamic damper, keep the shaft in a straight line and assemble the dynamic damper with the bands.
- 5. Assemble the transaxle side joint boot and bands.
- 6. Using the alignment marks (D) made during disassembly as a guide, install the spider assembly (A) and snap ring (B) on the driveshaft splines (C).



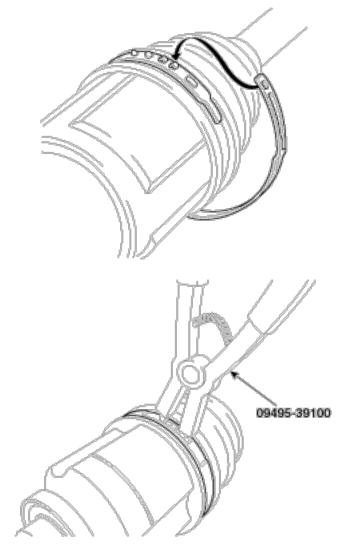


- 7. Add specified grease to the joint boot as much as it was wiped away at inspection.
- 8. Assemble the boot. To control the air in the transaxle side joint boot, keep the specified distance between the boot bands when they are tightened.

Engino	Standard value (L)		
Engine	LH	RH	
GSL MT	506.3mm (19.93in.)	728.3mm (28.67in.)	
GSL AT	482.3mm (18.99in.)	752.3mm (29.61in.)	
DSL MT	507.3mm (19.97in.)	706.3mm (27.81in)	
GSL MT (LPGi)	516.4mm (23.33in)	774mm (30.47in)	



9. Install the both boot bands using SST (09495-39100, 09495-3K000)



# 2016 > G 1.2 MPI > G 1.2 MPI > Driveshaft and axle > General Information > Special Service Tools

# **SPECIAL TOOLS**

Tool(Number and Name)	Illustration	Use
09495-3K000 Band installer		Installation of ear type boot band
09495-39100 Band installer		Installation of hook type boot band
09568-34000		ball joint remover

# **SPECIFICATIONS**

Driveshaft					
Funing	T/M	Joint type		Max. Permissible angle	
Engine		Outer	Inner	Outer	Inner
Gasoline	MT	AC 1500i	GI 1500i	46.5°	23°
		AC 1700i	GI 1700i	46.5°	23°
	AT	AC 1700i	GI 1500i	46.5°	23°
		AC 2000I	GI 1500i	46.5°	23°

# Tightening torques

ltem	Tightening torque (kgf.m)		
iteiii	Nm	kgf.m	lb-ft
Hub nuts	90.0 ~ 110.0	9.0 ~ 11.0	65.0 ~ 80.0
Driveshaft lock nut	245.0 ~ 275.0	24.5 ~ 27.5	177.0 ~ 199.0
Strut assembly to knuckle	100.0 ~ 120.0	10.0 ~ 12.0	72.0 ~ 87.0
Lower arm to knuckle	60.0 ~ 72.0	6.0 ~ 7.2	43.0 ~ 52.0
Tie rod end castle nut	24.0 ~ 34.0	2.4 ~ 3.4	17.0 ~ 25.0
Front caliper to knuckle	80.0 ~ 100.0	8.0 ~ 10.0	58.0 ~ 72.0
Rear caliper to torsion axle	65.0 ~ 75.0	6.5 ~ 7.5	47.0 ~ 54.0
Rear carrier to torsion axle	70.0 ~ 90.0	7.0 ~ 9.0	51.0 ~ 65.0

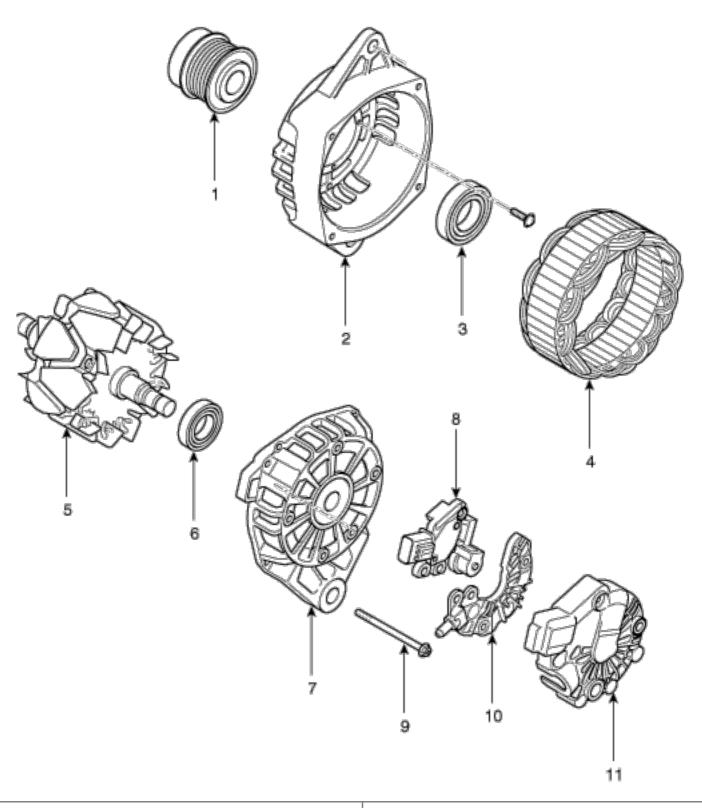
# **LUBRICANTS**

Engine	Drive Shaft		Lubricants	Quantity
KAPPA 1.0 MPI(MT)	Outer (BJ)	AC 1500i	2LN	76 ± 8g
	Inner (TJ)	GI 1500i	OLCi	110 ± 8g
KADDA 1 2 MDI/MT)	Outer (BJ)	AC 1700i	2LN	85 ± 10g
KAPPA 1.2 MPI(MT)	Inner (TJ)	GI 1700i	OLCi	123 ± 10g
KAPPA 1.0 MPI(AT)	Outer (BJ)	AC 1700i	2LN	85 ± 10g
	Inner (TJ)	GI 1500i	OLCi	110 ± 8g
KAPPA 1.2 MPI(AT)	Outer (BJ)	AC 2000i	2LN	90 ± 10g
	Inner (TJ)	GI 1500i	OLCi	110 ± 8g
KAPPA 1.0 LPGi(MT)	Outer (BJ)	BJ#21	RBA	90 + 0~10g
	Inner (TJ)	TJi#21	CW09-VX21	115 + 0~10g

# TROUBLESHOOTING

Trouble Symptom	Probable cause	Remedy
Vehicle pulls to one	Scoring of driveshaft ball joint	Replace
side	Wear, rattle or scoring of wheel bearing	Replace
	Defective front suspension and steering	Adjustment or Replace
Vibration	Wear, damage or bending of driveshaft	Replace
	Driveshaft rattle and hub serration	Replace
	Wear, rattle or scratching of wheel bearing	Replace
Shimmy	Defective wheel balance	Adjustment or Replace
	Defective front suspension and steering	Adjustment or Replace
	Wear, damage or bending of driveshaft	Replace
	Rattle of driveshaft and worn hub splines	Replace
Excessive noise	Wear, rattle or scoring of wheel bearing	Replace
	Loose hub nut	Adjustment or Replace
	Defective front suspension and steering	Adjustment or Replace

# **COMPONENTS**



- 1. OAP (Overrunning Alternator Pulley)
- 2. Front bracket
- 3. Front bearing
- 4. Stator
- 5. Rotor
- 6. Rear bearing

- 7. Rear bracket
- 8. Brush holder assembly
- 9. Through bolt
- 10. Rectifier assembly
- 11. Rear cover

## Engine Electrical System > Charging System > Alternator > Description and Operation

### **DESCRIPTION**

The Alternator has eight built-in diodes, each rectifying AC current to DC current.

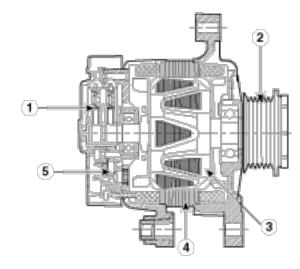
Therefore, DC current appears at alternator "B" terminal.

In addition, the charging voltage of this alternator is regulated by the battery voltage detection system.

The alternator is regulated by the battery voltage detection system.

The main components of the alternator are the rotor, stator, rectifier, capacitor brushes, bearings and V-ribbed belt pulley.

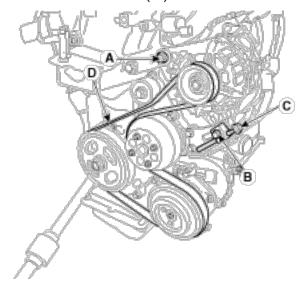
The brush holder contains a built-in electronic voltage regulator.



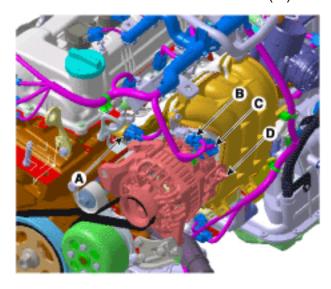
- 1. Brush
- 2. Drive belt pulley (OAP)
- 3. Rotor
- 4. Stator
- 5. Rectifier

## **REMOVAL**

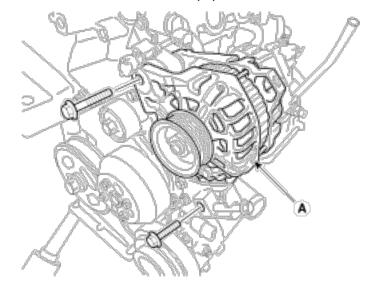
- 1. Disconnect the battery negative terminal.
- 2. Remove the drive belt.
  - (1) Loosen the alternator mounting bolts (A, B).
  - (2) Loosen the tension by turning the tension adjusting bolt (C) counterclockwise.
  - (3) Remove the drive belt (D).



- 3. Disconnect the intake OCV(Oil Control Valve) connector (A) and the knock sensor connector (B).
- 4. Disconnect the alternator connector (C) and the cable (D) from alternator "B" terminal.



5. Remove the alternator (A).



### **INSTALLATION**

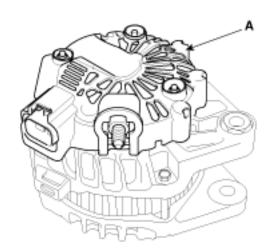
- 1. Install in the reverse order of removal.
- 2. Adjust the alternator belt tension after installation. (Refer to Engine Mechanical System "Drive Belt")

#### **Alternator installation bolt:**

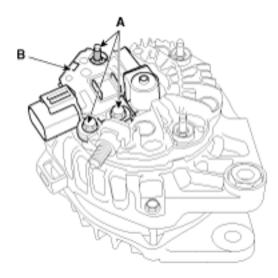
[12mm (0.47in) bolt] 21.6  $\sim$  32.4 Nm (2.2  $\sim$  3.3 kgf.m, 15.9  $\sim$  23.9 lb-ft) [14mm (0.55in) bolt] 29.4  $\sim$  41.2 Nm (3.0  $\sim$  4.2 kgf.m, 21.7  $\sim$  30.4 lb-ft)

### **DISASSEMBLY**

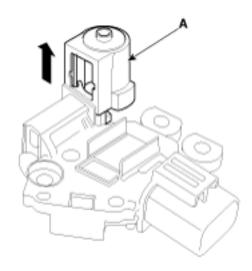
1. Remove the rear cover (A) after removing nuts.



2. Remove the mounting bolts (A) and the brush holder assembly (B).



3. Remove the slip ring guide (A) after pulling it.

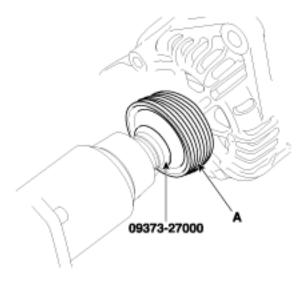


4. Remove the OAD(Overrunning Alternator Decoupler) cap.

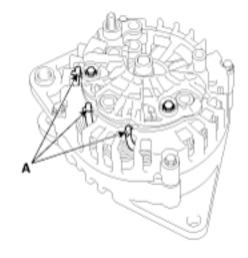
# NOTICE

When installing, replace with new OAD cap.

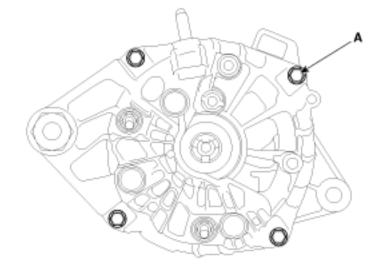
5. Remove the OAD (Overrunning Alternator Decoupler) pulley (A) using the special tool.



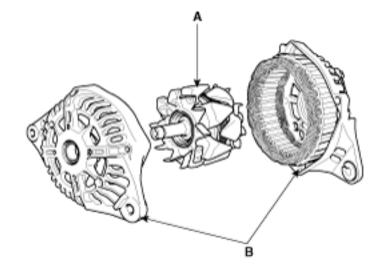
6. Unsolder the 3 stator leads (A).



7. Remove the 4 through bolts (A).



8. Disconnect the rotor (A) and bracket (B).



### **REASSEMBLY**

1. Reassemble in the reverse order of disassembly.

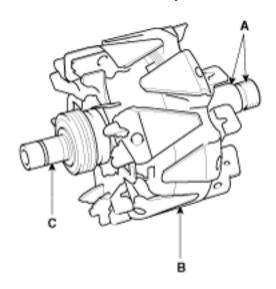
# NOTICE

• When reassembling OAD pulley, replace with new OAD cap.

### **INSPECTION**

# [Rotor]

1. Check that there is continuity between the slip rings (C).



- 2. Check that there is no continuity between the slip rings and the rotor (B) or rotor shaft (A).
- 3. If the rotor fails either continuity check, replace the alternator.

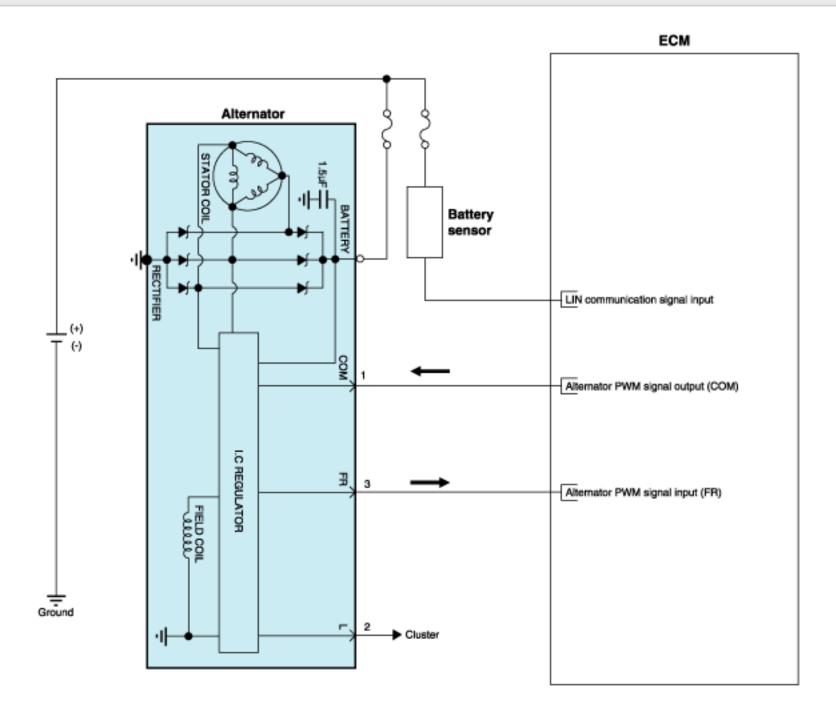
### [Stator]

4. Check that there is continuity between each pair of leads (A).



- 5. Check that there is no continuity between each lead and the coil core.
- 6. If the coil fails either continuity check, replace the alternator.

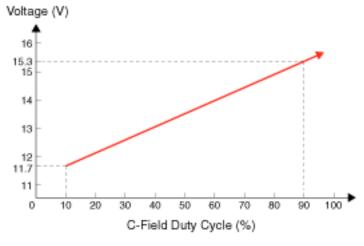
# **CIRCUIT DIAGRAM**



# **SPECIFICATION**

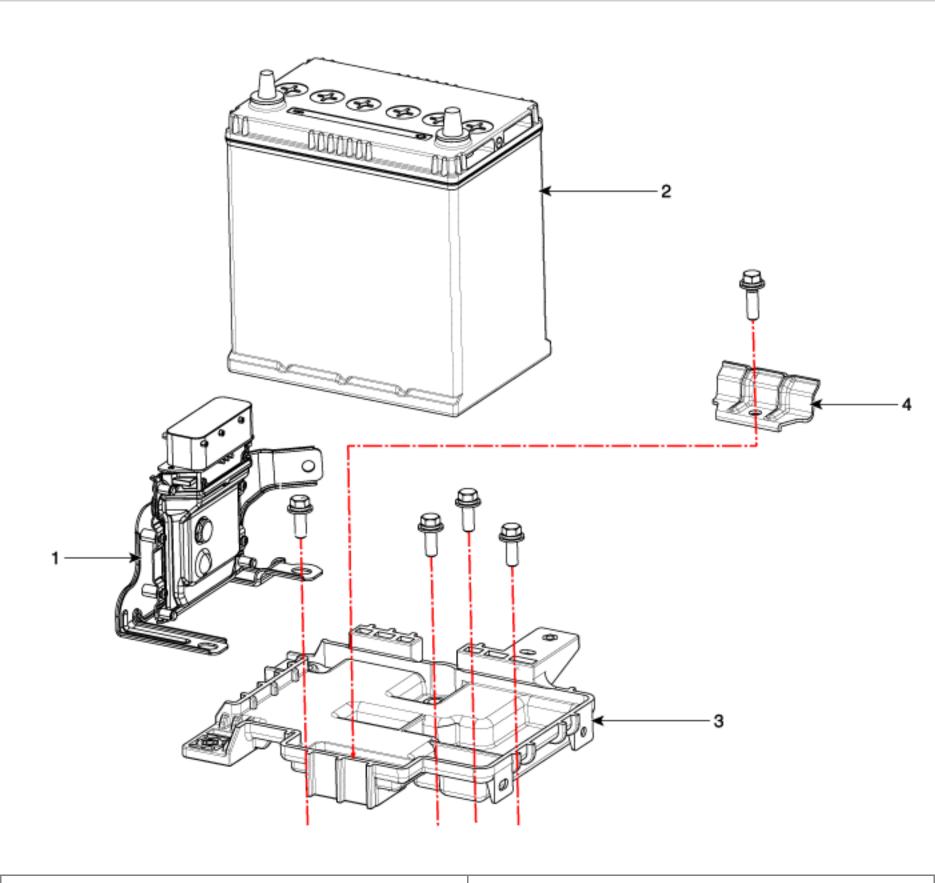
#### **Alternator**

Item		Specification
Rated voltage		13.5V, 90A
Speed	l in use	1,000 ~ 18,000 rpm
Voltage regulator		IC Regulator built-in type
Dogulator Satting Voltage	External mode	Refer to below graph
Regulator Setting Voltage	Internal mode	14.55 ± 0.2V
Temperature Gradient	External mode	0 ± 3 mV / °C
	Internal mode	-7 ± 3mV / °C



\* Regulator Setting Voltage (External mode)

# **COMPONENTS**

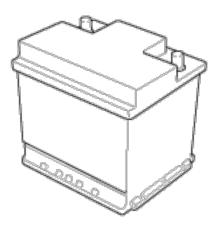


- 1. ECM
- 2. Battery

- 3. Battery tray
- 4. Battery mounting bracket

### **DESCRIPTION**

- 1. The maintenance-free battery is, as the name implies, totally maintenance free and has no removable battery cell caps.
- 2. Water never needs to be added to the maintenance-free battery.
- 3. The battery is completely sealed, except for small vent holes in the cover.



### NOTICE

After disconnecting then reconnecting the battery negative cable, reset some parts that require the reset procedures. (Refer to BE group – General Information)

#### [With ISG System]

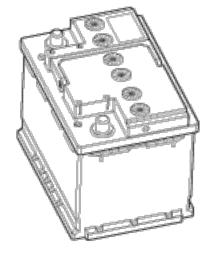
AGM battery is used for especially heavy load on the vehicle network depending on equipment and requirements. AGM stands for Absorbent Glass Material Battery; that is absorbent glass fibre fleece. AGM batteries are fitted in models with electrical loads/consumers which have a high energy demand.

The constantly increasing energy demand of modern vehicle electrical systems calls for ever more powerful battery solutions.

The power consumption is considerable even when the vehicle is parked.

The somewhat higher price compared with a battery of similar size is fully balanced by the following benefits:

- Significantly longer service life
- Increased starting reliability at low temperatures
- 100 % freedom from maintenance
- Low risk in event of an accident (reduced risk to the environment)



### Recharging [With ISG System]

#### Check the battery condition

The battery condition cannot be determined solely on the basis of the battery charge state. If there is a suspicion of a damaged battery, check the battery condition whit battery tester and investigate the cause by means of the test module. With a low battery charge state, recharge the battery.

### **Recharging the AGM battery**

The battery may be charged using the battery chargers at a constant charge voltage of 14.8V.

If possible, the battery temperature during charging should be between 20°C (68°F) and 30°C (86°F).

Only chargers with voltage clamping (IU or WU curve) may be used or chargers with IUoU curve which have a trickle.

#### IU or WU charging technique

Optimized charging voltage for IU or WU: 14.7V (at 20°C ~ 30°C (68°F ~ 86°F)) about 24 hours

Min. charging voltage at 20°C (68°F): 14.4V Max. charging voltage at 20°C (68°F): 14.8V

10% of capacity is recommended as charging current (e.g. 60Ah : 10 = 6,0A charging current).

### **AWARNING**

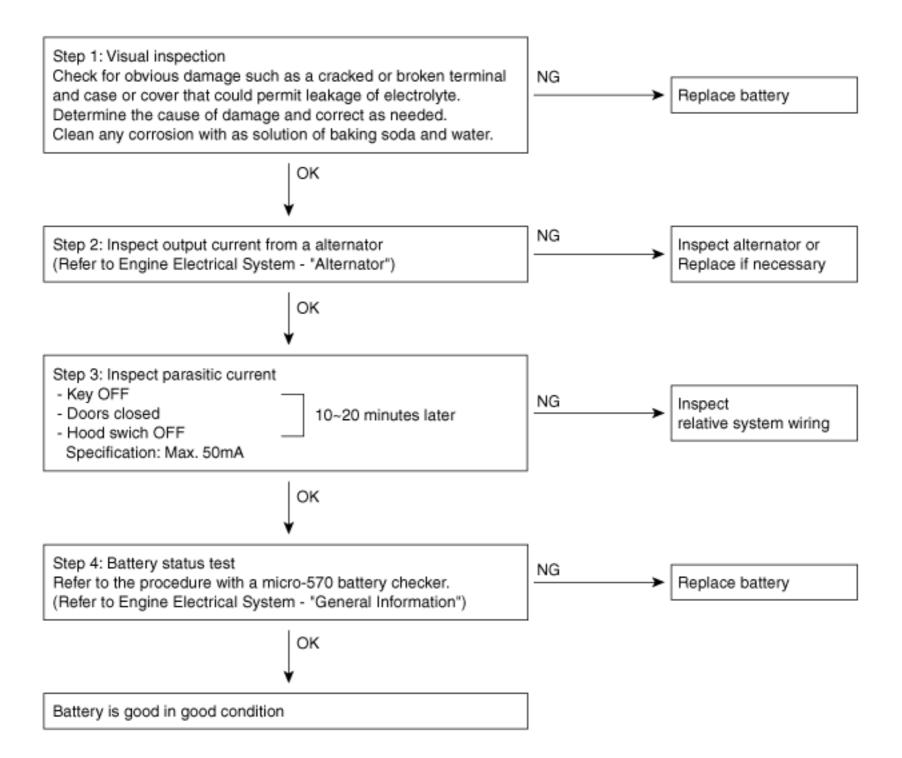
Do not charge the AGM battery with>15.2V. No quick-charging routines.

### **▲** CAUTION

If the battery is charged directly at the battery terminals on vehicles with battery sensor, misinterpretations of battery condition and under certain circumstances also unwanted Check Control messages or fault memory entire can occur.

After recharging finished, let the battery stand for over 10 hours with normal temperature for battery stabilization.

### **TROUBLESHOOTING**



### **REMOVAL AND INSTALLATION**

1. Disconnect the battery negative terminal.

### **Tightening torque**

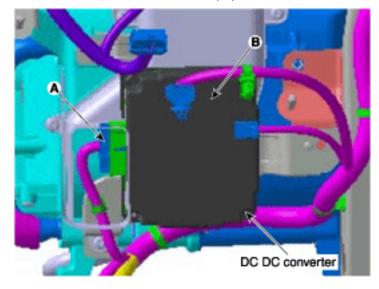
Without battery sensor:

 $7.8 \sim 9.8 \text{ N.m}$  (0.8 ~ 1.0 kgf.m,  $5.8 \sim 7.2 \text{ lb-ft}$ )

With battery sensor:

 $4.0 \sim 6.0 \text{ N.m} (0.4 \sim 0.6 \text{ kgf.m}, 3.0 \sim 4.4 \text{ lb-ft})$ 

- 2. Remove the audio assembly. (Refer to BE group)
- 3. Remove the glove box. (Refer to BD group)
- 4. Disconnect the connector (A) and then remove the DC/DC converter (B).



5. Installation is reverse order of removal.

### **NOTICE**

After disconnecting then reconnecting the battery negative cable, the ISG function dose not operates until the system is stabilized, about 4 hours.

#### **ON-VEHICLE INPECTION**

## i Information

• First of all, check for DTCs. If a DTC is present, perform troubleshooting in accordance with the procedure for that DTC. (Refer to DTC guide)

### **▲** CAUTION

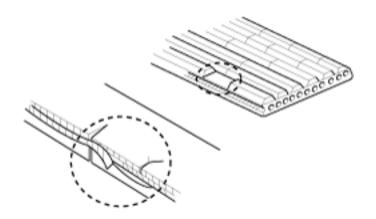
- Check that the battery cables are connected to the correct terminals.
- Disconnect the battery cables when the battery is given a quick charge.
- Never disconnect the battery while the engine is running.

### [General Inspection]

- 1. Check The Battery Terminals And Fuses
  - (1) Check that the battery terminals are not loose or corroded.
  - (2) Check the fuses for continuity.
- 2. Inspect Drive Belt
  - (1) Visually check the belt for excessive wear, frayed cords etc. If any defect has been found, replace the drive belt.

#### NOTICE

• Cracks on the rib side of a belt are considered acceptable. If the belt has chunks missing from the ribs, it should be replaced.



- Drive belt tension measurement and adjustment.
   (Refer to Engine Mechanical System "Drive Belt")
- 4. Visually Check Alternator Wiring And Listen For Abnormal Noises
  - (1) Check that the wiring is in good condition.
  - (2) Check that there is no abnormal noise from the alternator while the engine is running.
- 5. Check Discharge Warning Light Circuit

- (1) Warm up the engine and then turn it off.
- (2) Turn off all accessories.
- (3) Turn the ignition switch "ON". Check that the discharge warning light is lit.
- (4) Start the engine. Check that the light is lit.

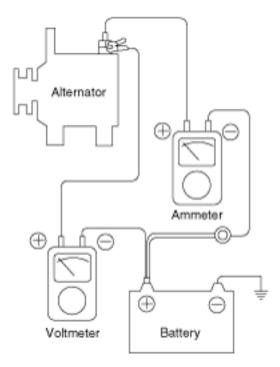
  If the light does not go off as specified, troubleshoot the discharge light circuit.

#### [Electrical Specified Value Inspection]

6. Voltage Drop Test Of Alternator Output Wire

This test determines whether or not the wiring between the alternator "B" terminal and the battery (+) terminal is good by the voltage drop method.

- (1) Preparation
  - a. Turn the ignition switch to "OFF".
  - b. Disconnect the output wire from the alternator "B" terminal. Connect the (+) lead wire of ammeter to the "B" terminal of alternator and the (-) lead wire of ammeter to the output wire. Connect the (+) lead wire of voltmeter to the "B" terminal of alternator and the (-) lead wire of voltmeter to the (+) terminal of battery.



#### (2) Test

- a. Start the engine.
- b. Turn on the headlamps and blower motor, and set the engine speed until the ammeter indicates 20A. And then, read the voltmeter at this time.
- (3) Result
  - a. The voltmeter may indicate the standard value.

#### Standard value: 0.2V max

- b. If the value of the voltmeter is higher than expected (above 0.2V max.), poor wiring is suspected. In this case check the wiring from the alternator "B" terminal to the battery (+) terminal. Check for loose connections, color change due to an over-heated harness, etc. Correct them before testing again.
- c. Upon completion of the test, set the engine speed at idle.

  Turn off the headlamps, blower motor and the ignition switch.

#### 7. Output Current Test

This test determines whether or not the alternator gives an output current that is equivalent to the normal output.

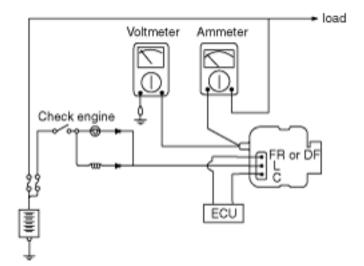
(1) Preparation

- a. Prior to the test, check the following items and correct as necessary.

  Check the battery installed in the vehicle to ensure that it is good condition. The battery checking method
  - Check the battery installed in the vehicle to ensure that it is good condition. The battery checking method is described in the section "Battery".
  - The battery that is used to test the output current should be one that has been partially discharged. With a fully charged battery, the test may not be conducted correctly due to an insufficient load.
  - Check the tension of the alternator drive belt. The belt tension check method is described in the section "Inspect drive belt".
- b. Turn off the ignition switch.
- c. Disconnect the battery ground cable.
- d. Disconnect the alternator output wire from the alternator "B" terminal.
- e. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire. Be sure to connect the (-) lead wire of the ammeter to the disconnected output wire.

### NOTICE

- Tighten each connection securely, as a heavy current will flow. Do not rely on clips.
- f. Connect a voltmeter (0 to 20V) between the "B" terminal and ground. Connect the (+) lead wire to the alternator "B" terminal and (-) lead wire to a good ground.
- g. Attach an engine tachometer and connect the battery ground cable.
- h. Leave the engine hood open.



#### (2) Test

- a. Check to see that the voltmeter reads as the same value as the battery voltage. If the voltmeter reads 0V, and the open circuit in the wire between alternator "B" terminal and battery (+) terminal or poor grounding is suspected.
- b. Start the engine and turn on the headlamps.
- c. Set the headlamps to high beam and the heater blower switch to HIGH, quickly increase the engine speed to 2,500 rpm and read the maximum output current value indicated by the ammeter.

### NOTICE

• After the engine start up, the charging current quickly drops. Therefore, the above operation must be done quickly to read the maximum current value correctly.

#### (3) Result

a. The ammeter reading must be higher than the limit value. If it is lower but the alternator output wire is in good condition, remove the alternator from the vehicle and test it.

**Limit value :** 60% of the voltage rate

### NOTICE

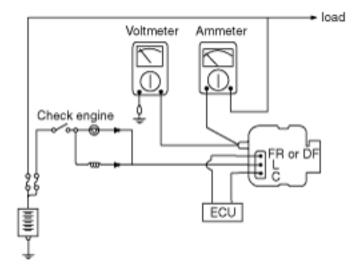
- The nominal output current value is shown on the nameplate affixed to the alternator body.
- The output current value changes with the electrical load and the temperature of the alternator itself.
  - Therefore, the nominal output current may not be obtained. If such is the case, keep the headlamps on the cause discharge of the battery, or use the lights of another vehicle to increase the electrical load.
- The nominal output current may not be obtained if the temperature of the alternator itself or ambient temperature is too high. In such a case, reduce the temperature before testing again.
- b. Upon completion of the output current test, lower the engine speed to idle and turn off the ignition switch.
- c. Disconnect the battery ground cable.
- d. Remove the ammeter and voltmeter and the engine tachometer.
- e. Connect the alternator output wire to the alternator "B" terminal.
- f. Connect the battery ground cable.

#### 8. Regulated Voltage Test

The purpose of this test is to check that the electronic voltage regulator controls voltage correctly.

#### (1) Preparation

- a. Prior to the test, check the following items and correct if necessary.
  - Check that the battery installed on the vehicle is fully charged. The battery checking method is described in the section "Battery".
  - Check the alternator drive belt tension. The belt tension check method is described in the section "Inspect drive belt".
- b. Turn ignition switch to "OFF".
- c. Disconnect the battery ground cable.
- d. Connect a digital voltmeter between the "B" terminal of the alternator and ground. Connect the (+) lead of the voltmeter to the "B" terminal of the alternator. Connect the (-) lead to good ground or the battery (-) terminal.
- e. Disconnect the alternator output wire from the alternator "B" terminal.
- f. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire. Connect the (-) lead wire of the ammeter to the disconnected output wire.
- g. Attach the engine tachometer and connect the battery ground cable.



a. Turn on the ignition switch and check to see that the voltmeter indicates the following value.

#### Voltage: Battery voltage

If it reads 0V, there is an open circuit in the wire between the alternator "B" terminal and the battery and the battery (-) terminal.

- b. Start the engine. Keep all lights and accessories off.
- c. Run the engine at a speed of about 2,500 rpm and read the voltmeter when the alternator output current drops to 10A or less

### (3) Result

- a. If the voltmeter reading dosen't agree with the standard value, the voltage regulator or the alternator is faulty.
- b. Upon completion of the test, reduce the engine speed to idle, and turn off the ignition switch.
- c. Disconnect the battery ground cable.
- d. Remove the voltmeter and ammeter and the engine tachometer.
- e. Connect the alternator output wire to the alternator "B" terminal.
- f. Connect the battery ground cable.

### **THE MICRO 570 ANALYZER**

The Micro 570 Analyzer provides the ability to test the charging and starting systems, including the battery, starter and alternator.

## **A** CAUTION

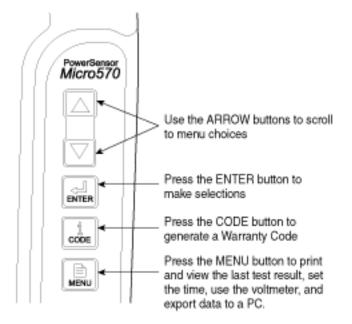
- \* Because of the possibility of personal injury, always use extreme caution and appropriate eye protection when working with batteries.
- \* When charging battery by test result, Battery must be fully charged.

To get accurate test result, battery surface voltage must have subsided ahead before test when you test battery after charged. (See following Battery Test Results)



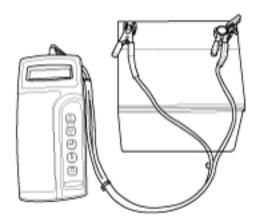
### Keypad

The Micro 570 button on the key pad provide the following functions:



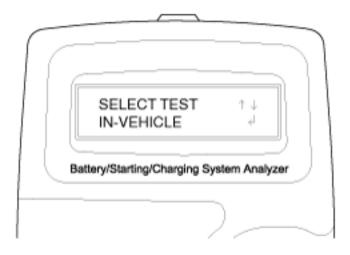
### **Battery Test Procedure**

- 1. Connect the tester to the battery.
  - Red clamp to battery positive (+) terminal.
  - Black clamp to battery negative (-) terminal.

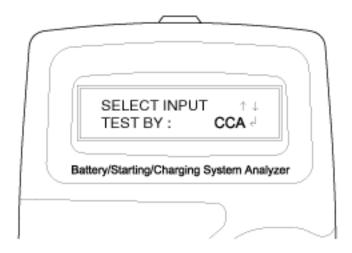


# **▲** CAUTION

- Connect clamps securely. If "CHECK CONNECTION" message is displayed on the screen, reconnect clamps securely.
- 2. The tester will ask if the battery is connected "IN-VEHICLE" or "OUT-OF-VEHICLE". Make your selection by pressing the arrow buttons; then press ENTER.

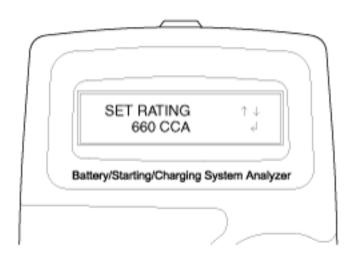


3. Select CCA and press the ENTER button.



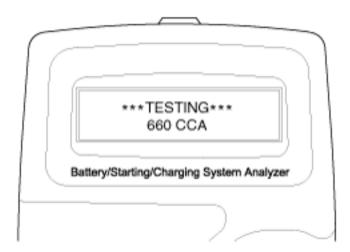
### NOTICE

- CCA: Cold cranking amps, is an SAE specification for cranking batteried at -0.4°F (-18°C).
- 4. Set the CCA value displayed on the screen to the CCA value marked on the battery label by pressing up and down buttons and press ENTER.



# NOTICE

- The battery ratings(CCA) displayed on the tester must be identical to the ratings marked on battery label.
- 5. The tester will conduct battery test.



6. The tester displays battery test results including voltage and battery ratings.

Refer to the following table and take the appropriate action as recommended by the Micro 570.



# **Battery Test Results**

Result On Printer	Remedy
GOOD BATTERY	No action is required.
GOOD RECHARGE	Battery is in a good state. Recharge the battery and use.  ** You have to follow instruction below when you charge battery and retest, otherwise test result can be inaccurate. (See 'Charge and Retest method after battery charge' below.)
CHARGE & RETEST	Battery is not charged properly.

	Charge and test the battery again.		
	* You have to follow instruction below when you charge battery and retest, otherwise test result can be inaccurate. (See 'Charge and Retest method after battery charge' below.)		
REPLACE BATTERY	Replace battery and recheck the charging system.		
	<ul> <li>Improper connection between battery and vehicle cables may cause "REPLACE BATTERY". Retest the battery after removing cables and connecting the tester to the battery terminal directly prior to replacing the battery.</li> </ul>		
BAD CELL-REPLACE	Charge and retest the battery.		
	<ul> <li>If the Micro 570 recommends "REPLACE BATTERY", replace the battery and recheck the charging system.</li> </ul>		

### [Charge and Retest method after battery charge]

#### **Battery charge**

Set battery charger to 'Auto Mode' (The Mode that charging current drops as the battery charges.) and charge battery until charging current down close to zero or the charger alerts you with an alarm when charge is complete. (Minimum charging time recommended: More than 3 hours with Auto Mode that explained above)

- If battery is not fully charged, battery surface voltage will be high while the amount of current charged (CCA) in battery is low. If you measure the battery under this condition, tester may misjudge that battery sulfation occurred because the amount of current in battery is too low in comparison with battery voltage.
  - \* Surface voltage: When battery is charged electrolyte temperature increases and chemical reaction become active resulting in an excessive increase of battery voltage.

It is known that it takes approximate one day to subside this increased surface voltage completely.

#### **Battery Test after charge**

Do not test battery right after the charge. Test battery after battery surface voltage has subsided as instructed in the following procedure.

- (1) When battery charge is complete, install the battery in the vehicle.
- (2) Put IG key to ON position and turn on head lamp with low beam, and wait 5 minutes. (Discharge for 5 minutes)
- (3) Turn off the head lamp and IG key, and wait 5 minutes. (Waiting for 5 minutes)
- (4) Remove +, cable from the battery and test battery.

## **▲** WARNING

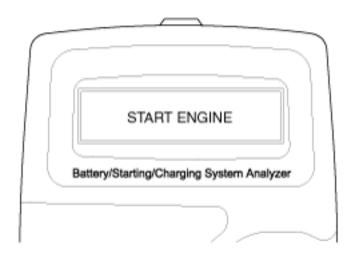
Whenever filing a claim for battery, the print out of the battery test results must be attached.

#### **Starter Test Procedure**

7. After the battery test, press ENTER immediately for the starter test.

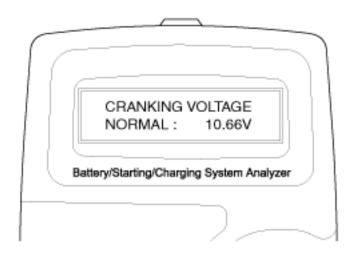


8. Start the engine.



9. Cranking voltage and starter test results will be displayed on the screen.

Refer to the following table and take the appropriate action as recommended by the Micro 570.



## **Starter Test Results**

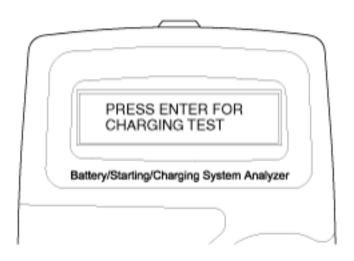
Result On Printer	Remedy
CRANKING VOLTAGE NORMAL	System shows a normal starter draw.
CRANKING VOLTAGE LOW	Cranking voltage is lower than normal level.  – Check starter.
CHARGE BATTERY	The state of battery charge is too low to test.  - Charge the battery and retest.
REPLACE BATTERY	Replace battery.      If the vehicle is not started though the battery condition of "GOOD BATTERY" is displayed, check wiring for open circuit, battery cable connection, starter and repair or replace as necessary.      If the engine does crank, check fuel system.

## NOTICE

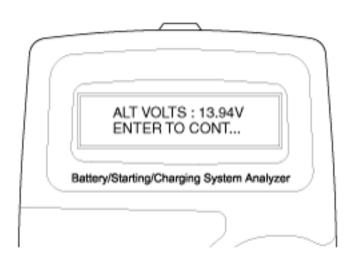
• When testing the vehicle with old diesel engines, the test result will not be favorable if the glow plug is not heated. Conduct the test after warming up the engine for 5 minutes.

## **Charging System Test Procedure**

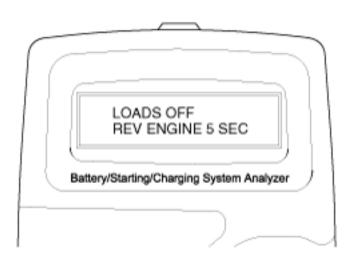
10. Press ENTER to begin charging system test.

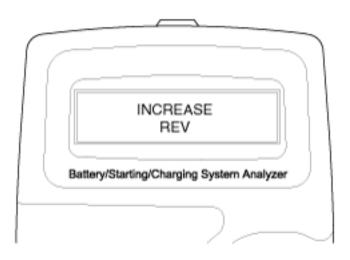


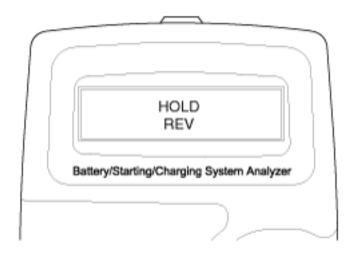
11. The tester displays the actual voltage of alternator. Press ENTER to continue.



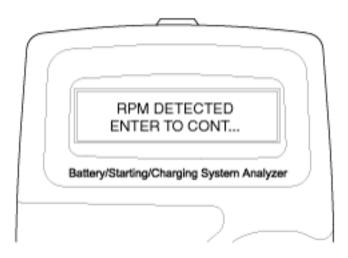
12. Turn off all electrical load and rev engine for 5 seconds with pressing the accelerator pedal. (Follow the instructions on the screen)



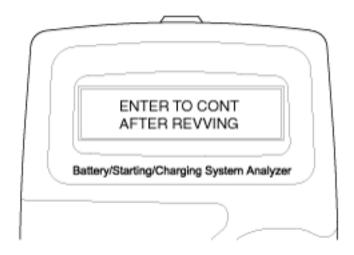




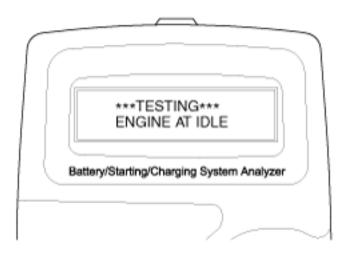
13. The message that engine RPM is detected will be displayed on the screen. Press ENTER to continue.

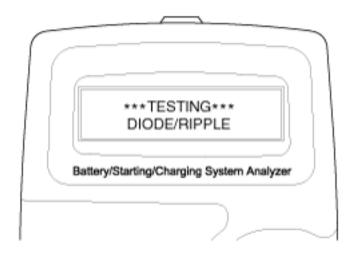


14. If the engine RPM is not detected, press ENTER after revving engine.

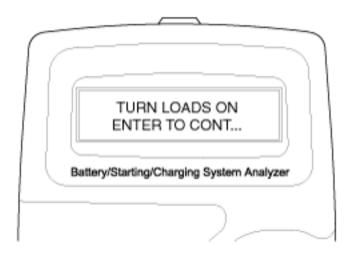


15. The tester will conduct charging system test during loads off.

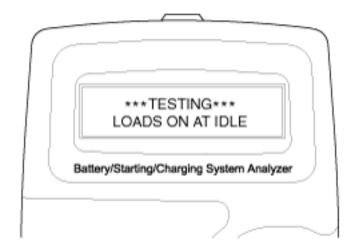




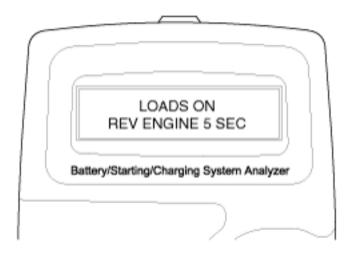
16. Turn on electrical loads (air conditioner, lamps, audio and etc). Press ENTER to continue.

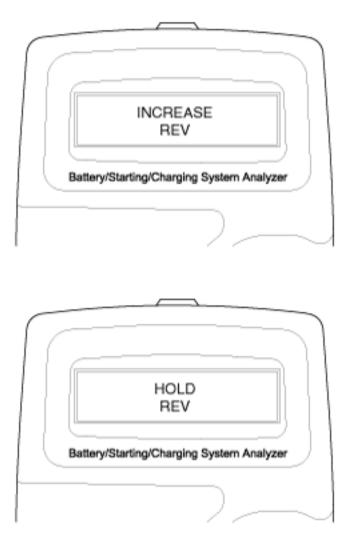


17. The tester will conduct charging system test during loads on.

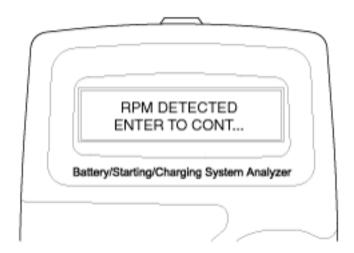


18. Rev engine for 5 seconds with pressing the accelerator pedal. (Follow the instructions on the screen)

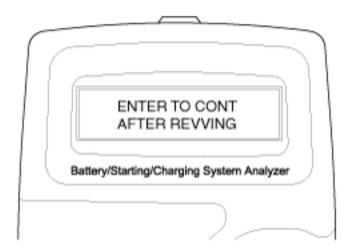




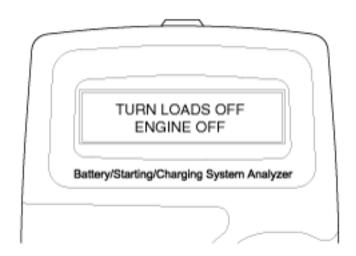
19. The message that engine RPM is detected will be displayed on the screen. Press ENTER to continue.



20. If the engine RPM is not detected, press ENTER after revving engine.

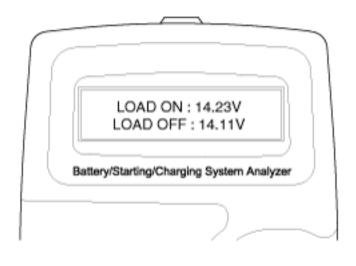


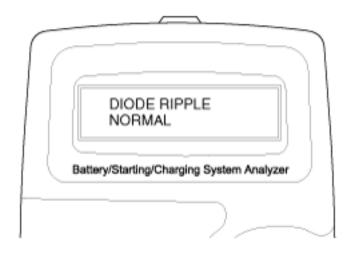
21. Turn off electrical loads (air conditioner, lamps, audio and etc). Turn the engine off.

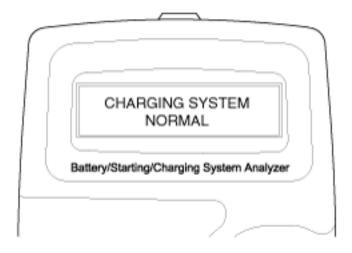


22. Charging voltage and charging system test results will be displayed on the screen.

Shut off engine end disconnect the tester clamps from the battery. Refer to the following table and take the appropriate action as recommended by the Micro 570.







## **Charging System Test Results**

Result On Printer	Remedy
CHARGING SYSTEM NORMAL	Charging system is normal.

/ DIODE RIPPLE NORMAL		
NO CHARGING VOLTAGE	Alternator does not supply charging current to battery.	
	Check belts, connection between alternator and battery and replace belts or cable or alternator as necessary.	
LOW CHARGING VOLTAGE	Alternator does not supply charging current to battery and electrical load to system fully.	
	Check belts and alternator and replace as necessary.	
HIGH CHARGING VOLTAGE	The voltage from alternator to battery is higher than normal limit during voltage regulating.	
	Check connection and ground and replace regulator as necessary.	
	Check electrolyte level in the battery.	
EXCESS RIPPLE DETECTED	One or more diodes in the alternator is not functioning properly.  - Check alternator mounting and belts and replace as necessary.	

## The MDX-670P Analyzer

The MDX-670P battery conductance and electrical system analyzer tests batteries as well as starting and charging systems for vehicle.

It displays the test results in seconds and features a built-in printer to provide a copy of the results.

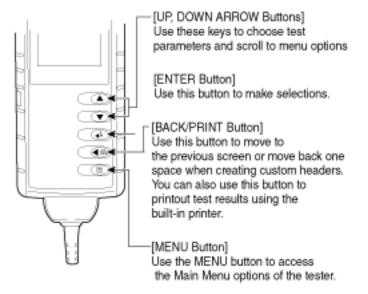


## **▲** CAUTION

- 1) Because of the possibility of personal injury, always use extreme caution and appropriate eye protection when working with batteries.
- 2) When charging battery by test result, Battery must be fully charged. To get accurate test result, battery surface voltage must have subsided ahead before test when you test battery after charged. (See following Battery Test Results)

### NOTICE

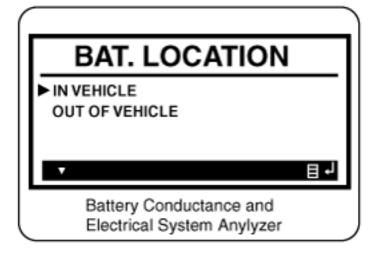
• When testing the vehicle with old diesel engines, the test result will not be favorable if the glow plug is not heated. Conduct the test after warming up the engine for 5 minutes.



1. Connect the red clamp to the positive (+) terminal and the black clamp to the negative (–) terminal.

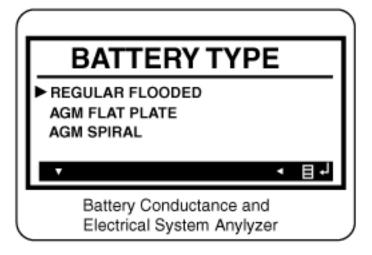
### NOTICE

- For a proper connection, rock the clamps back and forth. The tester requires that both sides of each clamp be firmly connected before testing. A poor connection will produce a CHECK CONNECTION or WIGGLE CLAMPS message. If the message appears, clean the terminals and reconnect the clamps.
- 2. Scroll to and select IN VEHICLE or OUT OF VEHICLE for a battery not connected to a vehicle.



## NOTICE

- Following an IN VEHICLE test you will be prompted to test the starting and charging systems.
- 3. Scroll to and select REGULAR FLOODED, AGM FLAT PLATE, or AGM SPIRAL where applicable.

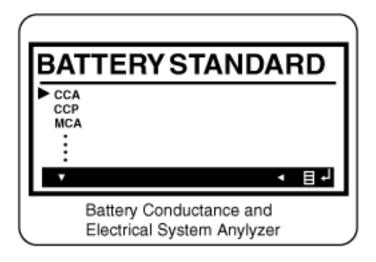


## NOTICE

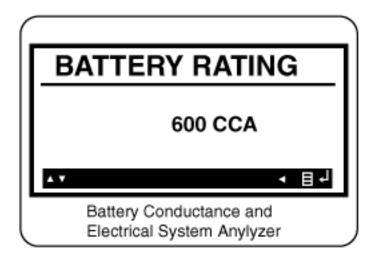
- If the vehicle equipped with ISG function, select the AGM FLAT PLATE.
- 4. Scroll to and select the battery's rating system.

### NOTICE

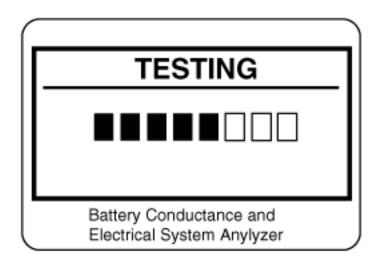
Mostly, the CCA value is marked on the battery label, but sometimes marked EN or SEA value. Select one
of them.



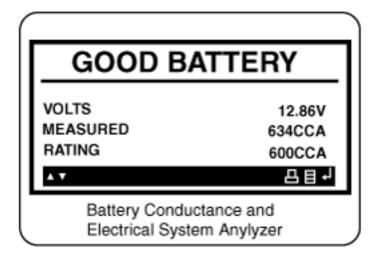
- CCA: Cold Cranking Amps, as specified by SAE. The most common rating for cranking batteries at 0 °F (–17.8 °C).
- EN: Europe-Norm
- SAE: Society of Automotive Engineers, the European labeling of CCA
- 5. Set the selected rating value displayed on the screen to the value marked on the battery label by pressing up and down arrow buttons.



6. Press ENTER to start test.



7. After several seconds the tester displays the decision on the battery's condition and the measured voltage. The tester also displays your selected battery rating and the rating units.



## **Battery Test Results**

Result On Printer	Remedy
GOOD BATTERY	No action is required.
GOOD RECHARGE	Battery is in a good state. Recharge the battery and use.  ** You have to follow instruction below when you charge battery and retest, otherwise test result can be inaccurate. (See 'Charge and Retest method after battery charge' below.)
CHARGE & RETEST	Battery is not charged properly.  — Charge and test the battery again.  ※ You have to follow instruction below when you charge battery and retest, otherwise test result can be inaccurate. (See 'Charge and retest method after battery charge' below.)
REPLACE BATTERY	Replace battery and recheck the charging system.  - Improper connection between battery and vehicle cables may cause "REPLACE BATTERY", retest the battery after removing cables and connecting the tester to the battery terminal directly prior to replacing the battery.
BAD CELLREPLACE	Charge and retest the battery.  – If recommends "REPLACE BATTERY", replace the battery and recheck the charging system.

# [Charge and Retest method after battery charge]

### **Battery charge**

Set battery charger to 'Auto Mode' (The Mode that charging current drops as the battery charges.) and charge battery until charging current down close to zero or the charger alerts you with an alarm when charge is complete. (Minimum charging time recommended: More than 3 hours with Auto Mode that explained above)

- If battery is not fully charged, battery surface voltage will be high while the amount of current charged (CCA) in battery is low. If you measure the battery under this condition, tester may misjudge that battery sulfation occurred because the amount of current in battery is too low in comparison with battery voltage.
  - \* Surface voltage: When battery is charged electrolyte temperature increases and chemical reaction become active resulting in an excessive increase of battery voltage.

It is known that it takes approximate one day to subside this increased surface voltage completely.

## **Battery Test after charge**

Do not test battery right after the charge. Test battery after battery surface voltage has subsided as instructed in the following procedure.

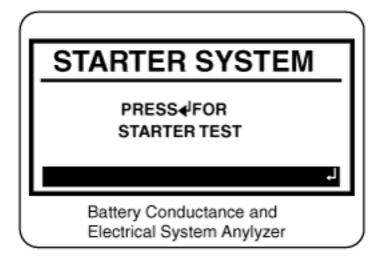
- (1) When battery charge is complete, install the battery in the vehicle.
- (2) Put IG key to ON position and turn on head lamp with low beam, and wait 5 minutes. (Discharge for 5 minutes)
- (3) Turn off the head lamp and IG key, and wait 5 minutes. (Waiting for 5 minutes)
- (4) Remove +, cable from the battery and test battery.

### NOTICE

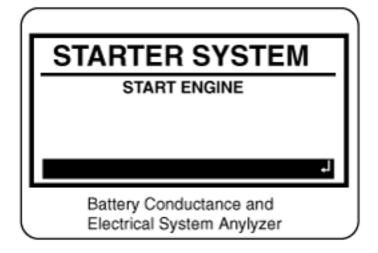
 For an in-vehicle test, the display alternates between the test results and the message "PRESS FOR STARTER TEST.

### NOTICE

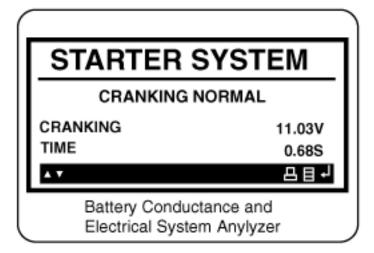
- Before starting the test, inspect the alternator drive belt. A belt that is glazed or worn, or lacks the proper tension, will prevent the engine from achieving the rpm levels needed for the test.
- 8. Press the ENTER button to proceed with the starter test.



9. Start the engine when prompted.



10. The tester displays the decision on the starter system, cranking voltage, and cranking time in milliseconds.



### **Starter Test Results**

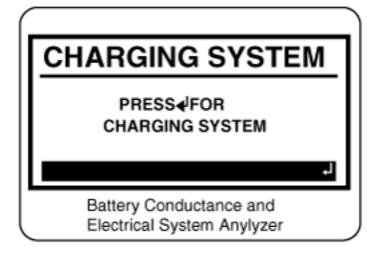
Result On Printer	Remedy
CRANKING VOLTAGE NORMAL	System shows a normal starter draw.
CRANKING VOLTAGE LOW	Cranking voltage is lower than normal level.  - Check starter.
CHARGE BATTERY	The state of battery charge is too low to test.  - Charge the battery and retest.
REPLACE BATTERY	Replace battery.  - If the vehicle is not started though the battery condition of "GOOD BATTERY" is displayed, check wiring for open circuit, battery cable connection, starter and repair or replace as necessary.
	If the engine does crank, check fuel system.

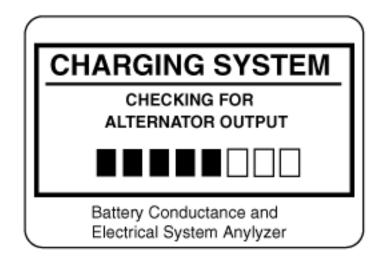
## NOTICE

• For an in-vehicle test, the display alternates between the test results and the message "PRESS FOR CHARGING TEST.

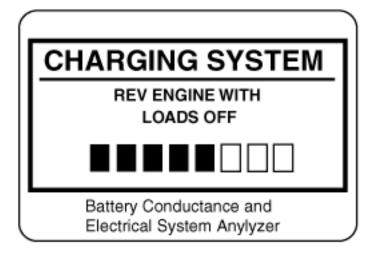
### **Step 3: Charging System Test**

11. Press the ENTER button to proceed with the charging test.

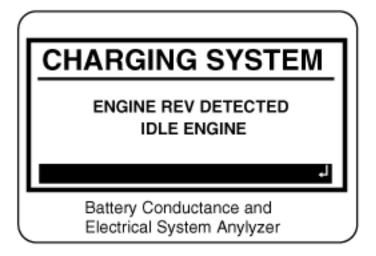




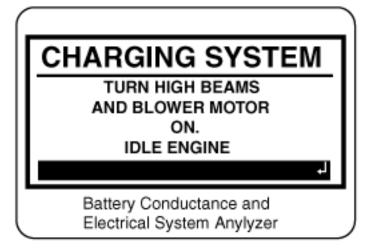
12. Rev the engine with loads off. (Following the on-screen prompts)



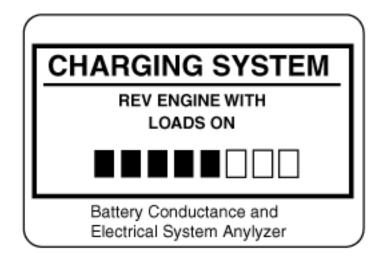
13. The message that engine RPM is detected will be displayed on the screen, idle the engine.



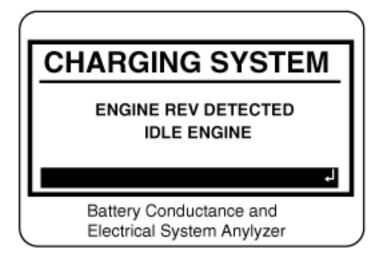
14. Turn on electrical loads (air conditioner, lamps, audio and etc). Press ENTER to continue.



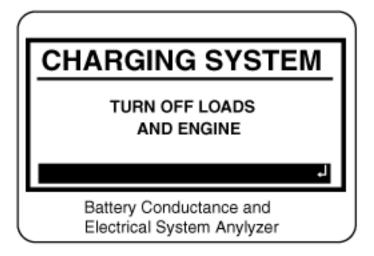
15. Turn on electrical loads (air conditioner, lamps, audio and etc). Press ENTER to continue.



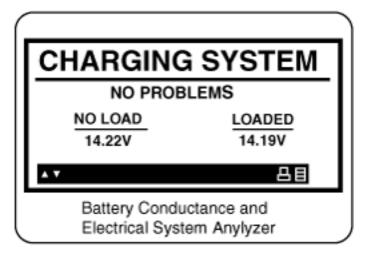
16. The message that engine RPM is detected will be displayed on the screen, idle the engine.



17. Turn off loads and engine.



18. The Charging System decision is displayed at the end of the procedure.



System is showing normal output from the alternator.	
No alternator output detected.	
Check all connections to and from the alternator, especially the connection to the battery. If the connection is loose or heavily corroded, clean or replace the cable and retest.	
<ul> <li>If the belts and connections are in good working condition, replace the alternator. (Older vehicles use external voltage regulators, which may require only replacement of the voltage regulator.)</li> </ul>	
Alternator does not supply charging current to battery and electrical load to system fully.	
Check belts and alternator and replace as necessary.	
The voltage from alternator to battery is higher than normal limit during voltage regulating.	
Check connection and ground and replace regulator as necessary.	
Check electrolyte level in the battery.	
The voltage from alternator to battery is higher than normal limit during voltage regulating.	
Check alternator mounting and belts and replace as necessary.	
The starter voltage is low and the battery is discharged. Fully charge the battery and repeat the starter system test.	
Battery must be replaced before the starting system can be tested.	

19. Press the BACK/PRINT button to print the test results or MENU to return to the Options Menu.

# Engine Electrical System > General Information > Special Service Tools

# SPECIAL SERVICE TOOLS

Tool (Number and name)	Illustration	Use
Alternator pulley remover wrench (09373-27000)		Removal and installation of alternator pulley

## **Engine Electrical System > General Information > Specifications**

## **SPECIFICATION**

## **Ignition System**

## Ignition Coil

Item	Specification
Primary Coil Resistance (Ω)	0.75 ± 10% [20°C (68°F)]
Secondary Coil Resistance (kΩ)	5.9 ± 15% [20°C (68°F)]

## Spark plug

Item		Specification
Туре	Туре	RER8WYPB4
Spark plugs	Gap	0.9 ~ 1.0 mm (0.0354 ~ 0.0394in.)

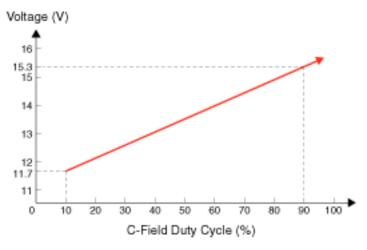
### Condenser

Item	Specification
Capacitance (uF)	0.47 [1KHz]
Insulation resistance (MΩ)	1,000 [DC 500 V/1 Min]

## **Charging System**

### Alternator

Item		Specification
Rated voltage		13.5V, 90A
Speed in use		1,000 ~ 18,000 rpm
Voltage regulator		IC Regulator built-in type
Regulator Setting Voltage	External mode	Refer to below graph
	Internal mode	14.55 ± 0.2V
Temperature Gradient	External mode	0 ± 3 mV / °C
	Internal mode	-7 ± 3mV / °C



\* Regulator Setting Voltage (External mode)

# Battery ► CMF40L-DIN

Item	Specification
Capacity [20HR/5HR] (AH)	40/32
Cold Cranking Amperage (A)	290 (SAE) / 360 (EN)
Reserve Capacity (Min)	55

### ► AGM60L-DIN : ISG

ltem	Specification
Capacity [20HR/5HR] (AH)	60/48
Cold Cranking Amperage (A)	640 (SAE) / 512 (EN)
Reserve Capacity (Min)	100

## i Information

- · Model type description
  - - : Battery specification
      - CMF : Closed Maintenance Free
      - MF: Maintenance Free
      - AGM : Absorbent Glass Mat
    - 2 : Battery capacity (20HR)
      - 68:68AH
    - 3 : Terminal location
      - L : Positive terminal is left
      - R : Positive terminal is right
    - 4 : Battery type
      - DIN: Deutsche Industric Normen
      - BCI: Battery Council International
- Cold Cranking Ampere (CCA): Cold Cranking Amps is a rating used in the battery industry to define a battery's ability to start an engine in cold temperatures.
- The rating is the number of amps a new, fully charged battery can deliver at -18 °C(-0.4 °F) for 30 seconds, while maintaining a voltage of at least 7.2 volts for a 12 volt battery.
- The higher the CCA rating, the greater the starting power of the battery.
- RESERVE CAPACITY (RC): Reserve Capacity is a battery industry rating, defining a battery's ability to power a vehicle with an inoperative alternator or fan belt.
- The rating is the number of minutes a battery at 26.7 °C(80 °F) can be discharged at 25 amps and maintain a voltage of 10.5 volts for a 12 volt battery.
- The higher the reserve rating, the longer your vehicle can operate should your alternator or fan belt fail.

### **Starting System**

## Starter

Item	Specification
Rated voltage	12 V, 0.9 kW
The number of pinion teeth	10

Performance	Ampere	Max. 58 A
[No-load, 11.5 V]	Speed	Min. 3000 rpm

# **TIGHTENING TORQUES**

Item	N.m	kgf.m	lb-ft
Ignition coil installation bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Spark plug installation	14.7 ~ 24.5	1.5 ~ 2.5	10.9 ~ 18.1
Condenser & Hanger bracket installation bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Alternator installation bolt [12 mm (0.47 in.)]	19.6 ~ 26.5	2.2 ~ 3.3	14.5 ~ 19.5
Alternator installation bolt [14 mm (0.55 in.)]	29.4 ~ 41.2	3.0 ~ 4.2	21.7 ~ 30.4
Battery (+) terminal tightening nut	7.8 ~ 9.8	0.8 ~ 1.0	5.2 ~ 8.7
Battery (-) terminal I tightening nut	7.8 ~ 9.8	0.8 ~ 1.0	5.2 ~ 8.7
Battery mounting bracket bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Battery tray installation bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Starter installation bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8

## **TROUBLESHOOTING**

**Symptom** 

### **Ignition System**

Engine will not start or is hard to start (Cranks OK)	Ignition lock switch	Inspect ignition lock switch, or replace as required
	Ignition coil	Inspect ignition coil, or replace as required
	Spark plugs	Inspect spark plugs, or replace as required
	Ignition wiring disconnected or broken	Repair wiring, or replace as required
Rough idle or stalls	Ignition wiring	Repair wiring, or replace as required
	Ignition coil	Inspect ignition coil, or replace as required
Engine hesitates/poor acceleration	Spark plugs and spark plug cables	Inspect spark plugs / cable, or replace as required
	Ignition wiring	Repair wiring, or replace as required
Poor mileage	Spark plugs and spark plug cables	Inspect spark plugs / cable, or replace as required
Charging System		

**Suspect Area** 

		as required
	Ignition wiring	Repair wiring, or replace as required
Poor mileage	Spark plugs and spark plug cables	Inspect spark plugs / cable, or replace as required
Charging System		
Symptom	Suspect Area	Remedy
Charging warning indicator does not	Suspect Area Fuse blown	Remedy Check fuses
, ,	•	•

- Electronic voltage regulator If light turns off, replace voltage regulator. Drive belt loose or worn Adjust belt tension or replace belt
- Charging warning indicator does not go out with engine running. (Battery requires frequent recharging)
- Battery cable loose, corroded or worn
- Electronic voltage regulator or alternator
- Wiring Electronic voltage regulator
- Voltage sensing wire

Repair or replace wiring Adjust belt tension or replace belt

Inspect wiring connection, repair or

If light turns off, replace voltage

Inspect cable connection, repair or

If light turns off, replace voltage

regulator or alternator

Repair or replace wiring

Remedy

Discharge

Overcharge

- Drive belt loose or worn
  - Wiring connection loose or short circuit Electronic voltage regulator or alternator
    - replace wiring If light turns off, replace voltage regulator or alternator

replace cable

regulator.

Poor grounding	Inspect ground or repair
Worn battery	Replace battery

## **Starting System**

Symptom	Suspect Area	Remedy
Engine will not crank	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn out	Repair or replace cables
	Transaxle range switch (Vehicle with automatic transaxle only)	Refer to AT group-automatic transaxle
	Fuse blown	Replace fuse
	Starter motor faulty	Replace
	Ignition switch faulty	Replace
Engine cranks slowly	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn out	Repair or replace cables
	Starter motor faulty	Replace
Starter keeps running	Starter motor faulty	Replace
	Ignition switch	Replace
Starter spins but engine will not crank	Short in wiring	Repair or replace wiring
	Pinion gear teeth broken or starter motor	Replace
	Ring gear teeth broken	Replace fly wheel or torque converter

## **Engine Electrical System > Ignition System > Description and Operation**

## **DESCRIPTION**

Ignition timing is controlled by the electronic control ignition timing system.

The standard reference ignition timing data for the engine operating conditions are pre-pro grammed in the memory of the ECM (Engine Control Module).

The engine operating conditions (speed, load, warm-up condition, etc.) are detected by the various sensors. Based on these sensor signals and the ignition timing data, signals to interrupt the primary current are sent to the ECM.

The ignition coil is activated, and timing is controlled.

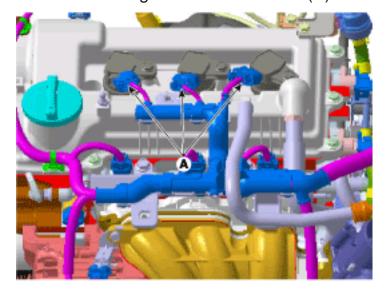
## Engine Electrical System > Ignition System > Ignition Coil > Description and Operation

## **DESCRIPTION**

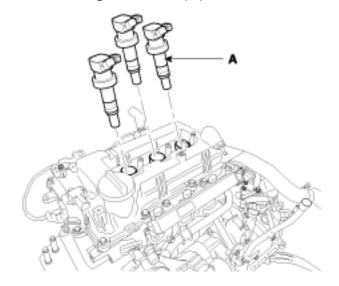
An ignition coil is an induction coil in an engine's ignition system which transforms the battery's low voltage to the high voltage needed to create an electric spark in the spark plugs to ignite the fuel. Coils have an internal resistor while others rely on a resistor wire or an external resistor to limit the current flowing into the coil from the battery 12 V supply.

## **REMOVAL**

- 1. Disconnect the battery nagative terminal.
- Remove the air cleaner. (Refer to Engine Mechanical System - "Air Cleaner")
- 3. Disconnect the ignition coil connector (A).

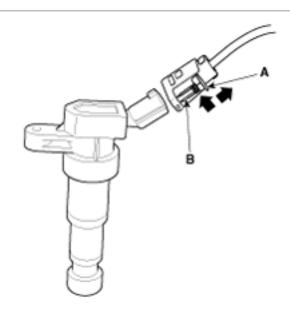


4. Remove the ignition coil (A).



## NOTICE

• When removing the ignition coil connector, pull the lock pin (A) and push the clip (B).



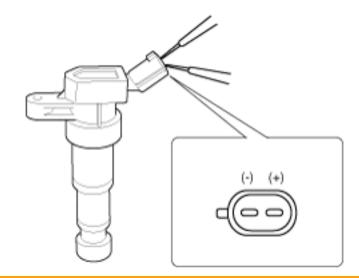
## **INSTALLATION**

1. Install in the reverse order of removal.

Center cover installation bolts:  $4.9 \sim 7.8$  N.m ( $0.5 \sim 0.8$  kgf.m,  $3.6 \sim 5.8$  lb-ft) Ignition coil installation bolts:  $9.8 \sim 11.8$  N.m ( $1.0 \sim 1.2$  kgf.m,  $7.2 \sim 8.7$  lb-ft)

## **INSPECTION**

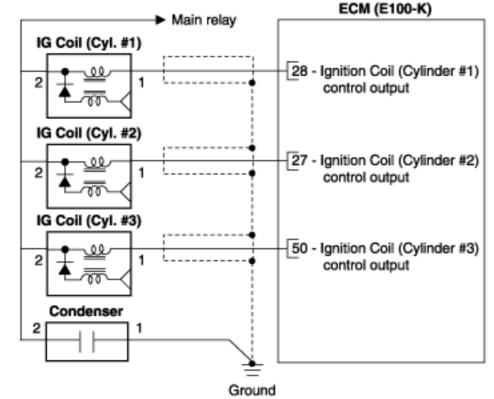
1. Measure the primary coil resistance between terminals (+) and (-).



**Standard value:**  $0.75\Omega \pm 10\%$ 

### **CIRCUIT DIAGRAM**

### [Circuit Diagram]



### [Connection Information]

### Ignition Coil #1 (E118-1)

Terminal	Connected to	Function
1	ECM E100-K (28)	Ignition Coil #1 control
2	Main relay	Battery power (B+)

### Ignition Coil #2 (E118-2)

Terminal	Connected to	Function
1	ECM E100-K (27)	Ignition Coil #2 control
2	Main relay	Battery power (B+)

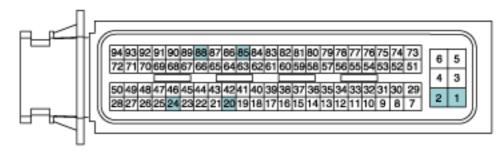
### Ignition Coil #3 (E118-3)

Terminal	Connected to	Function
1	ECM E100-K (50)	Ignition Coil #3 control
2	Main relay	Battery power (B+)

## [Harness Connector]



E118-1,2,3,4 Ignition Coil #1,2,3,4



E100-K ECM

# Engine Electrical System > Ignition System > Ignition Coil > Specifications

# SPECIFICATION

Item	Specification
Primary Coil Resistance (Ω)	0.75 ± 10% [20°C (68°F)]
Secondary Coil Resistance (kΩ)	5.9 ± 15% [20°C (68°F)]

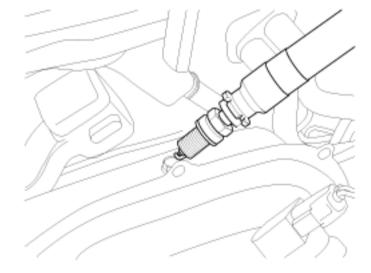
## **ON-VEHICLE INSPECTION**

### Inspect ignition coil assembly and Perform spark test

1. Check for DTCs.

## NOTICE

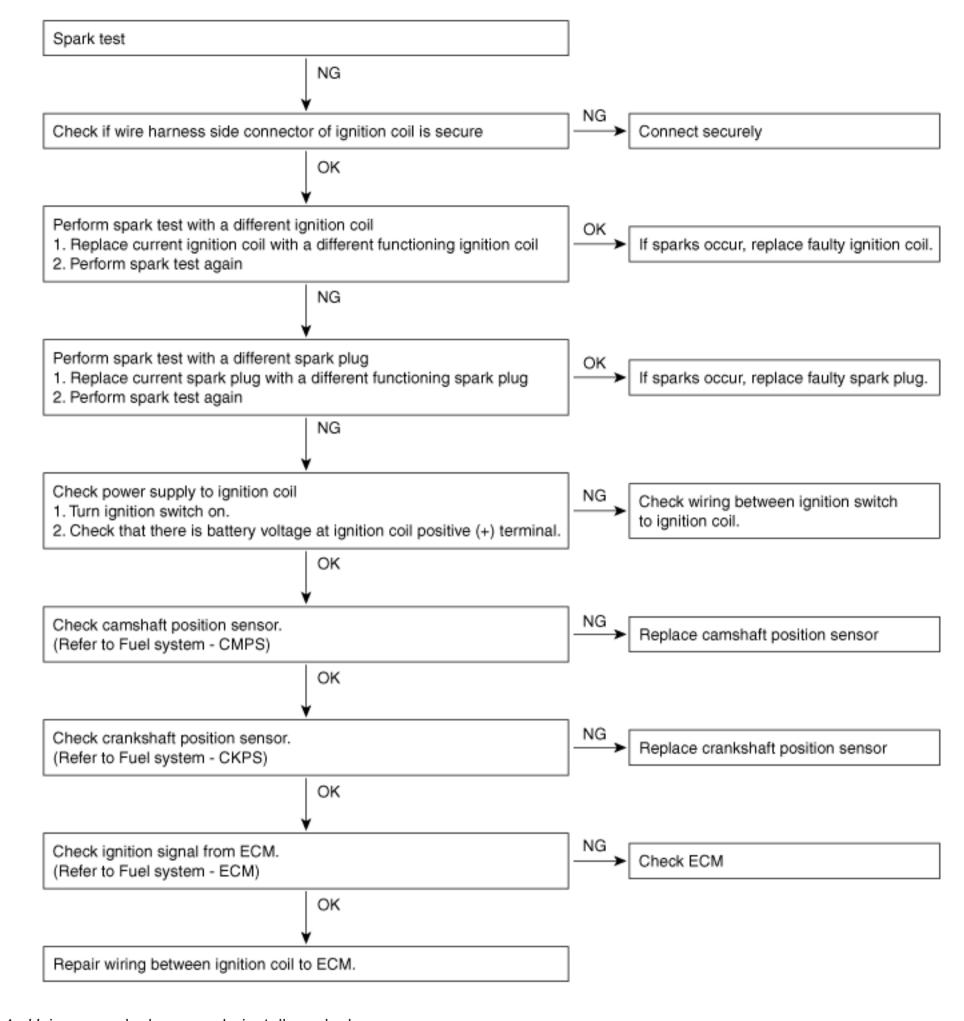
- If a DTC is present, perform troubleshooting in accordance with the procedure for that DTC. (Refer to DTC quide)
- 2. Check if sparks occur.
  - (1) Remove the engine cover.
  - (2) Remove the cylinder head center cover.
  - (3) Remove the ignition coils.
  - (4) Using a spark plug wrench, remove the spark plugs.
  - (5) Disconnect the 4 injector connectors.
  - (6) Ground the spark plug to the engine.



(7) Check if sparks occur at each spark plug while engine is being cranked.

## NOTICE

- Do not crank the engine for more then 5 seonds.
- 3. If sparks do not occur, perform the following test.



- 4. Using a spark plug wrench, install spark plugs.
- 5. Install the ignition coils.
- 6. Install the cylinder head center cover and the engine cover.

# Engine Electrical System > Ignition System > Spark Plug > Specifications

# SPECIFICATION

ltem		Specification	
Spark plugs	Туре	RER8WYPB4	
	Gap	0.9 ~ 1.0 mm (0.0354 ~ 0.0394in.)	

## **Engine Electrical System > Starting System > Description and Operation**

## **DESCRIPTION**

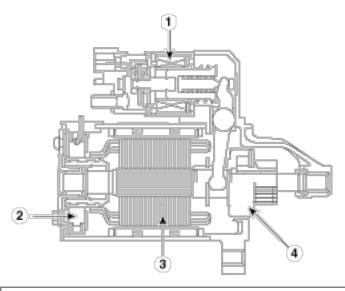
The starting system includes the battery, starter, solenoid switch, ignition switch, inhibitor switch (A/T), clutch pedal switch (M/T), ignition lock switch, connection wires and the battery cable.

When the ignition key is turned to the start position, current flows and energizes the starter motor's solenoid coil.

The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear.

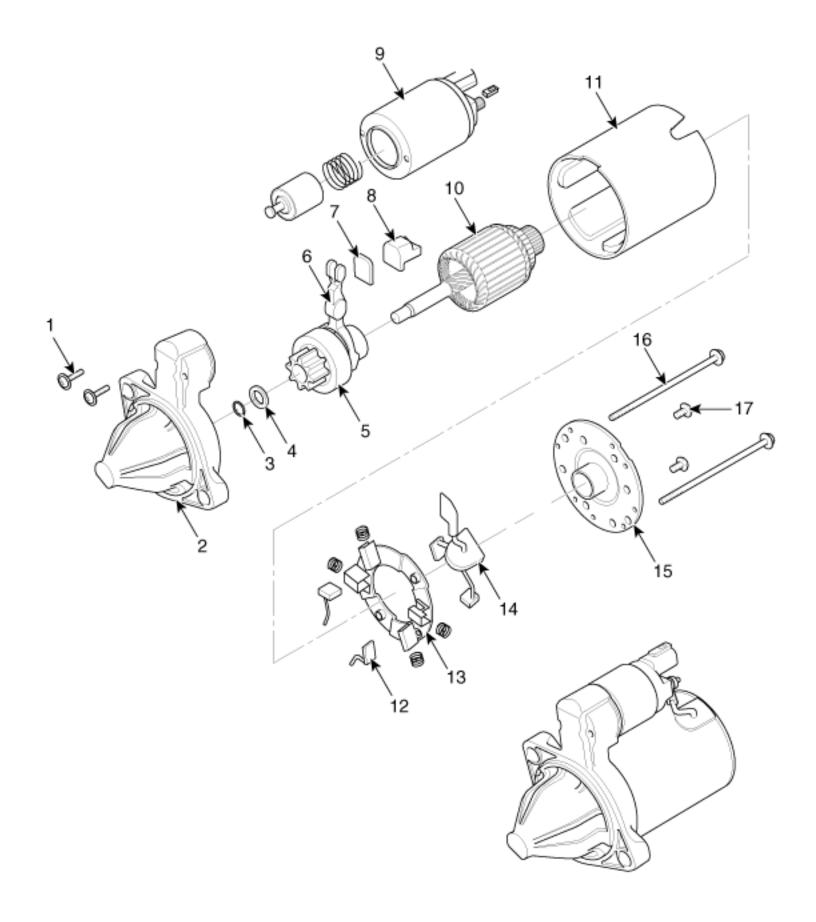
The contacts close and the starter motor cranks.

In order to prevent damage caused by excessive rotation of the starter armature when the engine starts, the clutch pinion gear overruns.



- 1. Solenoid
- 2. Brush assembly
- 3. Armature
- 4. Overrun clutch

## **COMPONENTS**



- 1. Screw
- 2. Front housing
- 3. Stop ring
- 4. Stopper
- 5. Overunn clutch
- 6. Lever
- 7. Lever plate
- 8. Lever packing
- 9. Magnet switch assembly

- 10. Armature assembly
- 11. Yoke assembly
- 12. Brush (-)
- 13. Brush holder
- 14. Brush (+)
- 15. Rear bracket
- 16. Through bolt
- 17. Screw

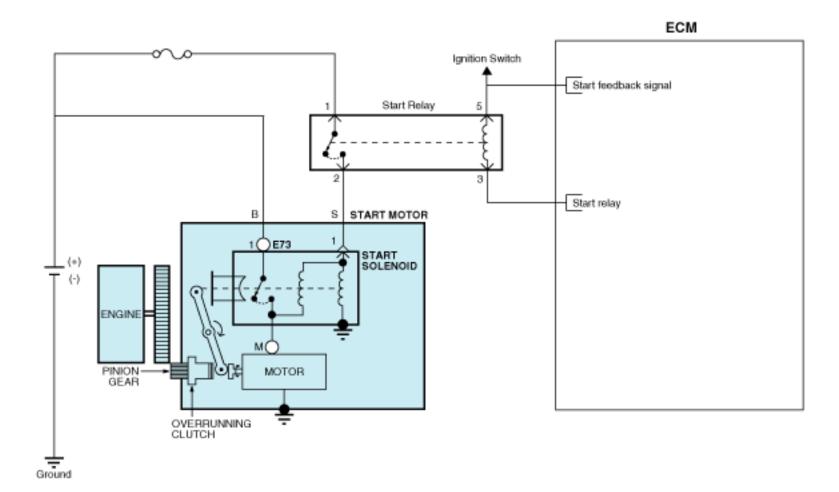
## **Engine Electrical System > Starting System > Starter > Description and Operation**

## **DESCRIPTION**

The starting system includes the battery, starter, solenoid switch, ignition switch, inhibitor switch (A/T), clutch pedal switch (M/T), ignition lock switch, connection wires and the battery cable.

- When the ignition key is turned to the start position, current flows and energizes the starter motor's solenoid coil.
- The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear. The contacts close and the starter motor cranks.
- In order to prevent damage caused by excessive rotation of the starter armature when the engine starts, the clutch pinion gear overruns.

## **CIRCUIT DIAGRAM**



### **TROUBLESHOOTING**

### NOTICE

• The battery must be in good condition and fully charged for this troubleshooting.

Disconnect the fuel pump fuse in the engine room fuse box. Turn the ignition switch to "START" at P or N shift lever position. (A/T) OK Turn the ignition switch to "START" while pressing the clutch pedal Starting system is OK. and the brake pedal. (M/T) Check if the engine is cranking normally. NG If pinion gear doesn't disengage from the ring gear when you release key, check for the following until you find the cause. Replace the starter Solenoid plunger and magnetic switch malfunction Dirty pinion gear or damaged overrunning clutch. OK Check the battery condition. (Positive/ Negative cable connection, Negative cable connection to the body, Engine ground cables, Starting system is OK. Starter "B" terminal connection and corrosion. After then try starting the engine again. NG Disconnect the connector from the S-terminal of solenoid. NG Connect the wire between solenoid B-terminal and solenoid S-terminal. Replace the starter Check if the engine is cranking normally. OΚ

Check the following items until you find the open circuit.

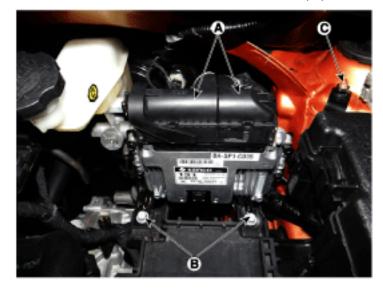
- Check the starter relay
- Check the wire and connectors between the fuse & relay box and the ignition switch
- Check the wire and connectors between the fuse & relay box and the starter.
- Check the ignition switch (Refer to Body Electrical System ignition switch)
- Check the key warning switch (Refer to Body Electrical System ignition switch)
- Check the inhibitor switch (A/T) (Refer to Automatic transaxle Inhibitor switch)
- Check the clutch switch (M/T) (Refer to Clutch system Clutch switch)
- Check the brake switch (M/T) (Refer to BR Brake switch)

### **REMOVAL**

- 1. Disconnect the battery (-)terminal (A) and then (+)terminal (B).
- 2. Remove the battery mounting bracket (C) and then remove the battery.



- 3. Disconnect the ECM connector (A).
- 4. Remove the bracket installation bolts (B) and nut (C).



5. Remove the battery tray installation bolts (A).



### **INSTALLATION**

1. Install in the reverse order of removal.

**Battery (-)terminal installation:** 

 $7.8 \sim 9.8 \text{ N.m}$  (0.8 ~ 1.0 kgf.m,  $5.8 \sim 7.2 \text{ lb-ft}$ )

**Battery (+)terminal installation:** 

 $7.8 \sim 9.8 \text{ N.m}$  (0.8 ~ 1.0 kgf.m,  $5.8 \sim 7.2 \text{ lb-ft}$ )

**Battery mounting bracket insulation bolt:** 

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

Battery tray installation bolts:

8.8 ~ 13.7 N.m (0.9 ~ 1.4 kgf.m, 6.5 ~ 10.1 lb-ft)

#### VEHICLE PARASITIC CURRENT INSPECTION

- 1. Turn the all electric devices OFF, and then turn the ignition switch OFF.
- 2. Close all doors except the engine hood, and then lock all doors.
  - (1) Disconnect the hood switch connector.
  - (2) Close the trunk lid.
  - (3) Close the doors or remove the door switches.
- 3. Wait a few minutes until the vehicle's electrical systems go to sleep mode.

### NOTICE

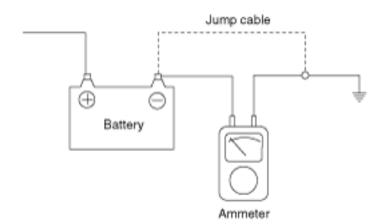
- For an accurate measurement of a vehicle parasitic current, all electriacl systems should go to sleep mode. (It takes at least one hour or at most one day.) However, an approximate vehicle parasitic current can be measured after 10~20 minutes.
- 4. Connect an ammeter in series between the battery (-) terminal and the ground cable, and then disconnect the clamp from the battery (-) terminal slowly.

### NOTICE

• Be careful that the lead wires of an ammeter do not come off from the battery (-) terminal and the ground cable to prevent the battery from being reset. In case the battery is reset, connect the battery cable again, and then start the engine or turn the ignition switch ON for more than 10 sec. Repeat the procedure from No. 1.

To prevent the battery from being reset during the inspection,

- a. Connect a jump cable between the battery (-) terminal and the ground cable.
- b. Disconnect the ground cable from the battery (-) terminal.
- c. Connect an ammeter between the battery (-) terminal and the ground cable.
- d. After disconnecting the jump cable, read the current value of the ammeter.



- 5. Read the current value of the ammeter.
  - If the parasitic current is over the limit value, search for abnormal circuit by removing a fuse one by one and checking the parasitic current.
  - Reconnect the suspected parasitic current draw circuit fuse only and search for suspected unit by removing a compoconnected with the circuit one by one until the parasitic draw drops below limit value.

Limit value (after 10~20 min.): Below 50mA

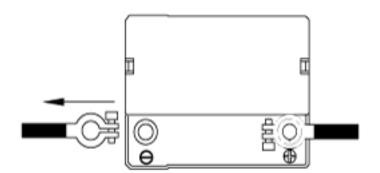
#### **CLEANING**

- 1. Make sure the ignition switch and all accessories are in the OFF position.
- 2. Disconnect the battery cables (negative first).
- 3. Remove the battery from the vehicle.

## **▲** CAUTION

 Care should be taken in the event the battery case is cracked or leaking, to protect your skin from the electrolyte.

Heavy rubber gloves (not the household type) should be wore when removing the battery.



- 4. Inspect the battery tray for damage caused by the loss of electrolyte. If acid damage is present, it will be necessary to clean the area with a solution of clean warm water and baking soda. Scrub the area with a stiff brush and wipe off with a cloth moistened with baking soda and water.
- 5. Clean the top of the battery with the same solution as described above.
- 6. Inspect the battery case and cover for cracks. If cracks are present, the battery must be replaced.
- 7. Clean the battery posts with a suitable battery post tool.

- 8. Clean the inside surface of the terminal clamps with a suitable battery cleaning tool. Replace damaged or frayed cables and broken terminal clamps.
- 9. Install the battery in the vehicle.
- 10. Connect the cable terminals to the battery post, making sure tops of the terminals are flush with the tops of the posts .
- 11. Tighten the terminal nuts securely.
- 12. Coat all connections with light mineral grease after tightening.

### **▲** CAUTION

- When batteries are being charged, an explosive gas forms beneath the cover of each cell. Do not smoke near batteries being charged or which have recently been charged. Do not break live circuit at the terminals of batteries being charged.
  - A spark will occur when the circuit is broken. Keep open flames away from battery.

# Engine Electrical System > Charging System > Battery > Specifications

## **SPECIFICATIONS**

## ► CMF40L-DIN

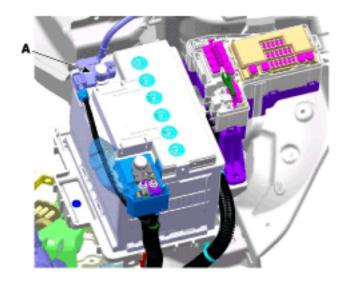
Item	Specification
Capacity [20HR/5HR] (AH)	40/32
Cold Cranking Amperage (A)	290 (SAE) / 360 (EN)
Reserve Capacity (Min)	55

► AGM60L-DIN : ISG

ltem	Specification
Capacity [20HR/5HR] (AH)	60/48
Cold Cranking Amperage (A)	640 (SAE) / 512 (EN)
Reserve Capacity (Min)	100

### **DESCRIPTION**

Vehicles have many control units that use more electricity. These units control their own system based on information from diverse sensors. It is important to have a stable power supply as there diverse sensors giving a variety of information. Battery sensor (A) is mounted on battery (-) terminal. It transmits battery voltage, current, temperature information to ECM. ECM controls generating voltage by duty cycle based on these signals.



### **▲** CAUTION

When battery sensor signal fault occurs, inspect the vehicle parasitic draw in advance after inspecting the sensor because the sensor will behave abnormally when the parasitic draw is more than 100mA. (Refer to vehicle parasitic current inspection)

### NOTICE

It takes a few hours for a new battery sensor to detect the battery state correctly. Perform the following process after replacing the battery sensor.

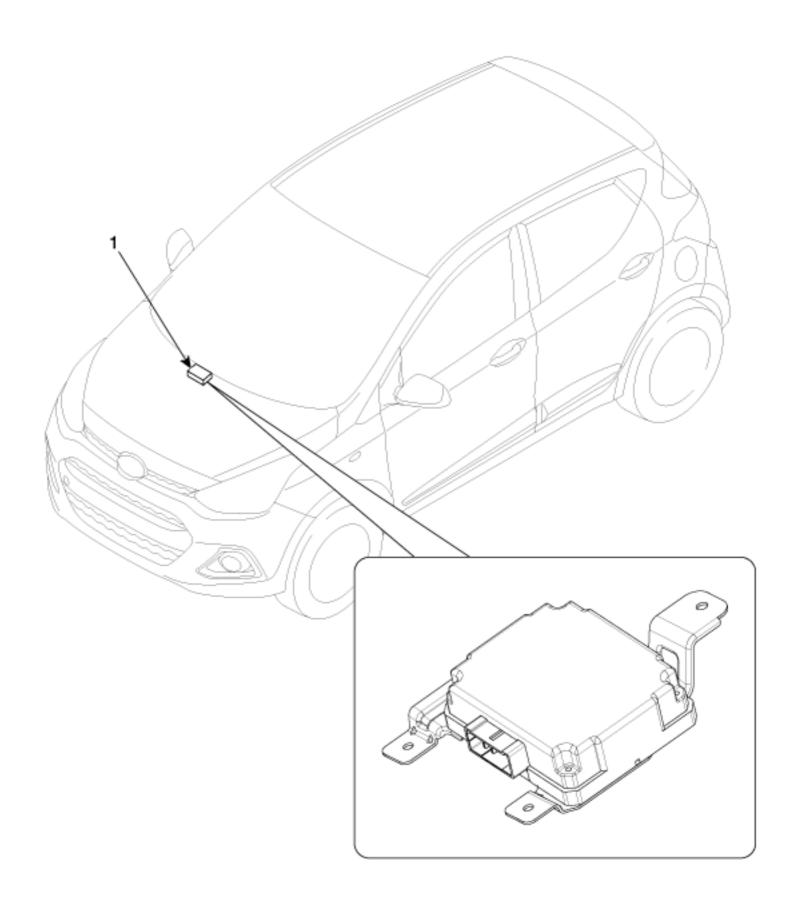
- 1) Ignition switch ON/OFF.
- 2) Park the vehicle about 4 hours.
- 3) After 4 hours later, check that the SOC (State of charge) of battery is displayed on GDS properly.
- 4) After engine start ON/OFF 2 times or more, check the SOF (State of function) of battery using GDS.

### **▲** CAUTION

For the vehicle equipped with a battery sensor, be careful not to damage the battery sensor when the battery is replaced or recharged.

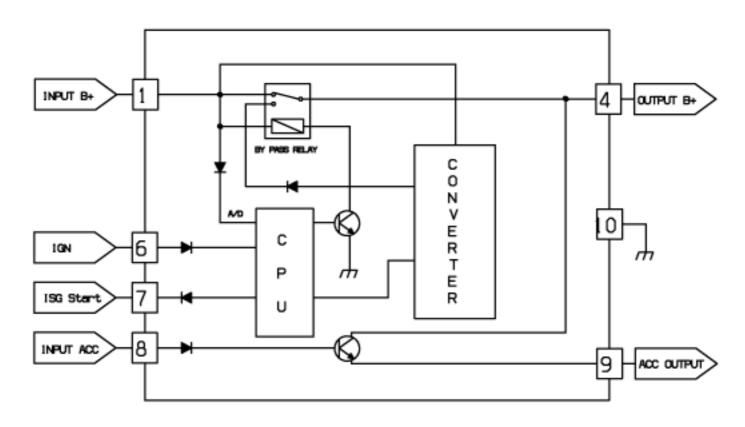
- When replacing the battery, it should be same one (type, capacity and brand) that is originally installed on your vehicle. If a battery of a different type is replaced, the battery sensor may recognize the battery to be abnormal.
- When installing the ground cable on the negative post of battery, tighten the clamp with specified torque of 4.0~6.0N.m (0.4~0.6kgf.m, 3.0~4.4lb-ft). An excessive tightening torque can damage the PCB internal circuit and the battery terminal.
- When recharging the battery, ground the negative terminal of the booster battery to the vehicle body.

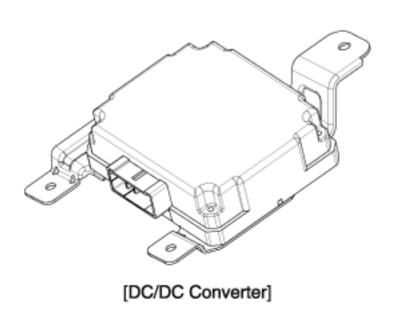
## **COMPONENT LOCATION**



1. DC/DC Converter

### **CIRCUIT DIAGRAM**







PIN NO.	DESCRIPTION	REMARKS
1	INPUT B+	
2	-	
3	-	
4	OUTPUT B+	Audio,Amplifier
5	-	
6	IGN	
7	ISG START	
8	INPUT ACC	
9	OUTPUT ACC	Audio signal Input
10	GND	
11	-	

## NOTICE

In case of IGN 2 with connecting battery, input the signal 'ISG Start' then BY PASS RELAY will be ON, after boosting voltage (12±0.6V) of low battery, if the battery voltage is over 12±0.5V then BY PASS RELAY will be OFF. In the ISG mode, if the power of an audio system turns OFF by drawdown while "Auto Starting" or "Idle Starting" function operates, replace the DC/DC converter.

### **Engine Electrical System > Charging System > Description and Operation**

### **DESCRIPTION**

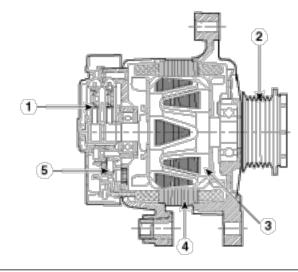
The charging system included a battery, an alternator with a built-in regulator, and the charging indicator light and wire.

The Alternator has eight built-in diodes, each rectifying AC current to DC current.

Therefore, DC current appears at alternator "B" terminal.

In addition, the charging voltage of this alternator is regulated by the battery voltage detection system.

The alternator is regulated by the battery voltage detection system. The main components of the alternator are the rotor, stator, rectifier, capacitor brushes, bearings and V-ribbed belt pulley. The brush holder contains a built-in electronic voltage regulator.



- 1. Brush
- 2. Drive belt pulley (OAP)
- 3. Rotor
- 4. Stator
- 5. Rectifier

### **Alternator Management System**

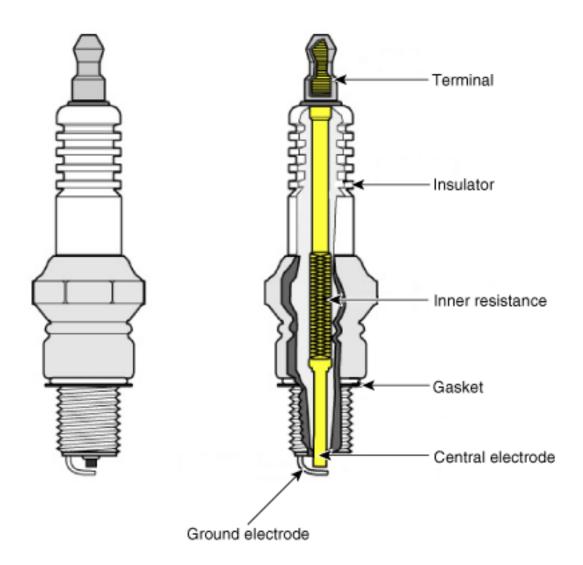
Alternator management system controls the charging voltage set point in order to improve fuel economy, manage alternator load under various operating conditions, keep the battery charged, and protect the battery from over-charging. ECM controls generating voltage by duty cycle (charging control, discharging control, normal control) based on the battery conditions and vehicle operating conditions.

The system conducts discharging control when accelerating a vehicle. Vehicle reduces an alternator load and consumes an electric power form a battery.

The system conducts charging control when decelerating a vehicle. Vehicle increases an alternator load and charges a battery.

## **DESCRIPTION**

A spark plug is a device for delivering electric current from an ignition system to the combustion chamber of a spark-ignition engine to ignite the compressed fuel/air mixture therein by means of an electric spark, while containing combustion pressure within the engine. A spark plug has a metal threaded shell, electrically isolated from a central electrode by a porcelain insulator.



### Engine Electrical System > Ignition System > Spark Plug > Repair procedures

### **INSPECTION**

### [On vehicle inspection]

- 1. Accelerate the engine to about 3,000 rpm 3 times or more.
- 2. Remove the spark plug.
- Check the spark plug visually.
   If the electrode is dry, the spark plug is normal.
   If the electrode is wet, check the damage and electrode gap as below.

### [Component Inspection]

- 4. Check the spark plug for any damage on its thread and insulator. If there is damage, replace the spark plug.
- 5. Check the electrode. Measure the insulation resistance with an ohmmeter. If the resistance is less than the specified value, adjust the electrode gap.

**Specification**: 10  $M\Omega$  or more

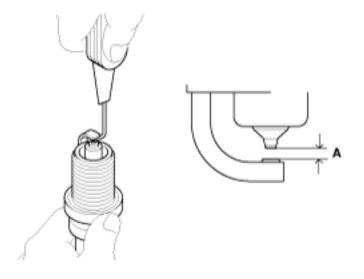


6. Check the spark plug electrode gap.

If the gap is greater than the maximum, replace the spark plug.

### NOTICE

• If adjusting the gap of a new spark plug, bend only the base of the ground electrode. Do not touch the tip. Never attempt to adjust the gap on a used plug.

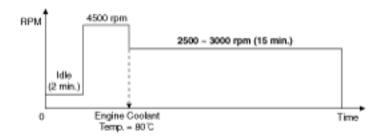


### **CLEANING**

The combustion temporarily becomes unstable, due to the aged fuel and the carbon deposits accumulated on the spark plug(s) after long-term storage.

### [1st Method]

- 1. Start the engine and keep the engine running at idle for 2 minutes.
- 2. Step on the accelerator pedal and hold it steady at 4500 rpm with the shift lever in N position to warm up the engine until the temperature of the engine coolant reaches 80°C.
- 3. Keep the engine running at 2500~3000 rpm in the N position for 15 minutes.



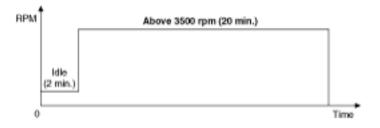
### [2nd Method]

### NOTICE

- The 2nd method should be performed only if the 1st method fails (the misfire-related codes recur).
- 4. Start the engine and keep the engine running at idle for 2 minutes.
- 5. Drive the vehicle for over 20 minutes, keeping the engine speed above 3500 rpm.

### NOTICE

• If equipped with manual transaxle, shift the gear properly for keeping the engine speed above 3500 rpm.

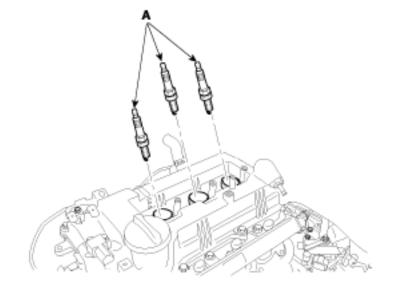


### **REMOVAL**

- Remove the ignition coil.
   (Refer to Ignition System "Ignition Coil")
- 2. Using a spark plug wrench, remove the spark plug (A).

### NOTICE

Be careful that no contaminates enter into spark plug holes.



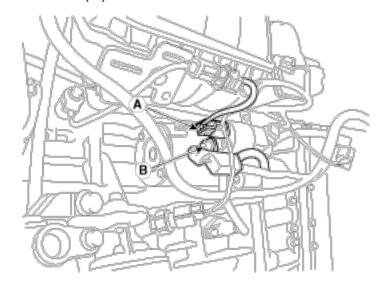
## **INSTALLATION**

1. Install in the reverse order of removal.

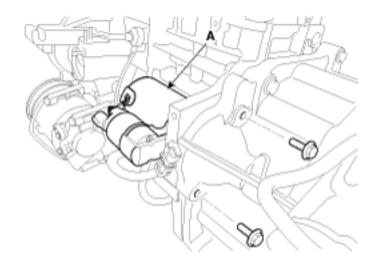
**Tightening torque:** 14.7 ~ 24.5 N.m (1.5 ~ 2.5 kgf.m, 10.8 ~ 18.0 lb-ft)

### **REMOVAL**

- 1. Disconnect the battery negative terminal.
- Remove the air duct and air cleaner assembly.
   (Refer to Engine Mechanical System "Air Cleaner")
- 3. Disconnect the starter cable (B) from the B terminal on the solenoid then disconnect the connector from the S terminal (A).



4. Remove the 2 bolts holding the starter, then remove the starter (A).



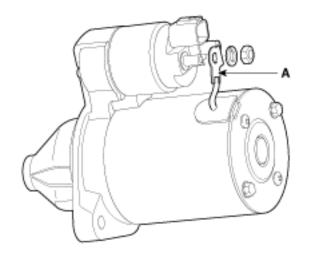
### **INSTALLATION**

1. Install in the reverse order of removal.

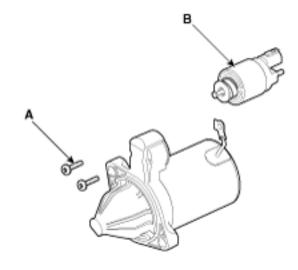
**Starter installation bolt:** 49.0 ~ 63.7 N.m (5.0 ~ 6.5 kgf.m, 36.2 ~ 47.0 lb-ft)

### **DISASSEMBLY**

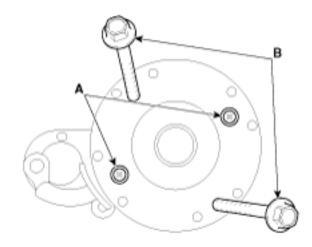
1. Disconnect the M-terminal (A) on the magnet switchassembly.



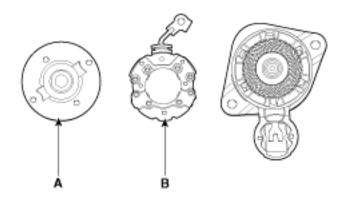
2. After loosening the 2 screws (A), detach the magnetswitch assembly (B).



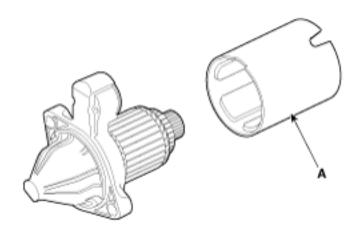
3. Loosen the brush holder mounting screw (A) and the trough bolts (B).



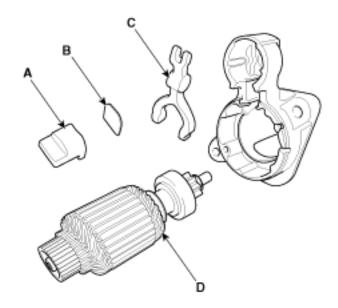
4. Remove the rear bracket (A) and brush holderassembly (B).



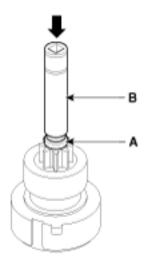
5. Remove the yoke (A).



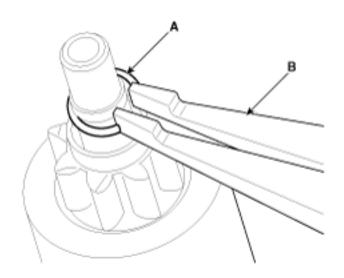
6. Remove the packing (A), lever plate (B), lever (C), armature (D).



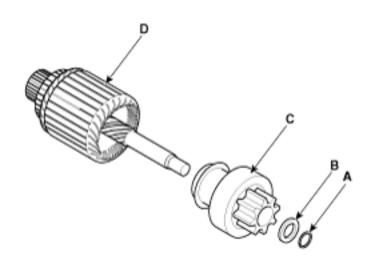
7. Press the stopper (A) using a socket (B).



8. After removing the stop ring (A) using stopper pliers (B).

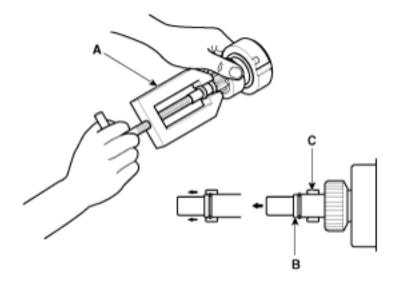


9. Remove the stop ring (B), stopper (A), overrunningclutch (C) and armature (D).



## i Information

• Using a suitable pulling tool (A), pull the overrunningclutch stopper (C) over the stop ring (B).



### **REASSEMBLY**

1. Reassemble in the reverse order of disassembly.

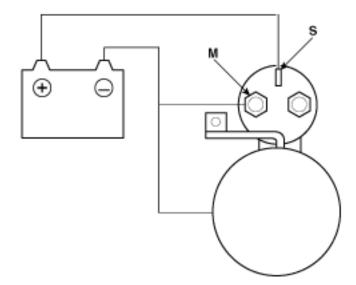
## **INSPECTION**

### **Starter Solenoid Inspection**

- 1. Disconnect the lead wire from the M-terminal of solenoid switch.
- 1. Connect the battery as shown. If the starter pinion pops out, it is working properly.

### **NOTICE**

• To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.

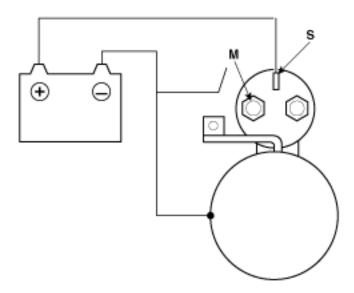


2. Disconnect the battery from the M terminal.

If the pinion does not retract, the hold-in coil is working properly.

### NOTICE

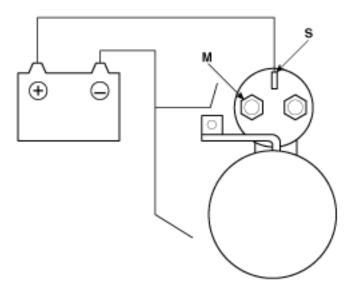
• To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.



3. Disconnect the battery also from the body. If the pinion retracts immediately, it is working properly.

## NOTICE

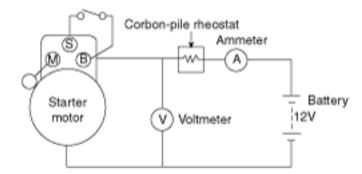
• To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.



### Free Running Inspection

4. Place the starter motor in a vise equipped with soft jaws and connect a fully-charged 12-volt battery to starter motor

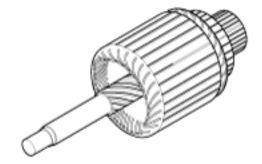
- as follows.
- 1. Connect a test ammeter (150-ampere scale) and carbon pile rheostats shown is the illustration.
- 2. Connect a voltmeter (15-volt scale) across starter motor.



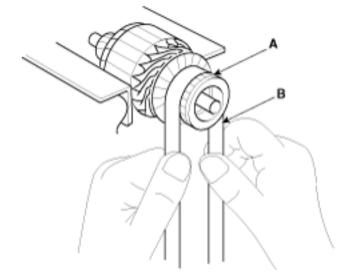
- 3. Rotate carbon pile to the off position.
- 4. Connect the battery cable from battery's negative post to the starter motor body.
- 5. Adjust until battery voltage shown on the voltmeter reads 11volts.
- 6. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely.

### **Armature**

- 7. Remove the starter.
- 1. Disassemble the starter as shown at the beginning of this procedure.
- 2. Inspect the armature for wear or damage from contact with the permanent magnet. If there is wear or damage, replace the armature.



3. Check the commutator (A) surface. If the surface is dirty or burnt, resurface with emery cloth or a lathe within the following specifications, or recondition with #500 or #600 sandpaper (B).



4. Check the commutator diameter. If the diameter is below the service limit, replace the armature.

#### **Commutator diameter**

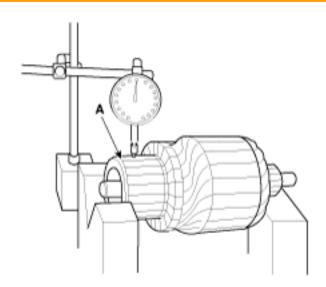
Standard (New) : 29.4 mm (1.1575 in) Service limit : 28.8 mm (1.1339 in)



- 5. Measure the commutator (A) runout.
  - If the commutator runout is within the service limit, check the commutator for carbon dust or brass chips between the segments.
  - If the commutator run out is not within the service limit, replace the armature.

#### **Commutator runout**

Standard (New): 0.05mm (0.0020in.) max Service limit: 0.10mm (0.0039in.) max

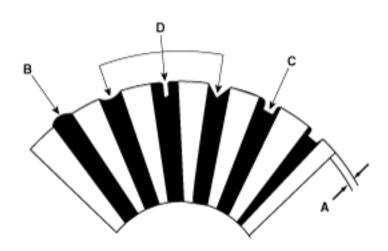


6. Check the mica depth (A). If the mica is too high (B), undercut the mica with a hacksaw blade to the proper depth. Cut away all the mica (C) between the commutator segments. The undercut should not be too shallow, too narrow, or v-shaped (D).

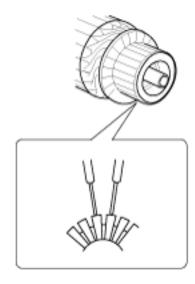
#### Commutator mica depth

Standard (New): 0.5 mm (0.0197 in.)

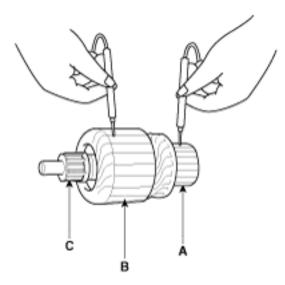
Limit: 0.2mm (0.0079 in.)



7. Check for continuity between the segments of the commutator. If an open circuit exists between any segments, replace the armature.



8. Check with an ohmmeter that no continuity exists between the commutator (A) and armature coil core (B), and between the commutator and armature shaft (C). If continuity exists, replace the armature.

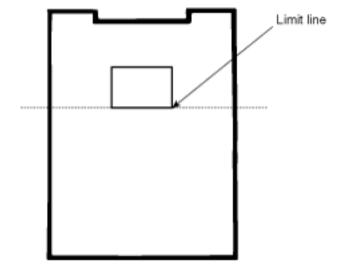


#### **Starter Brush**

9. Brushes that are worm out, or oil-soaked, should be replaced.

### **Bruch length**

Standard : 12.3 mm (0.4843 in) Service linit : 5.5 mm (0.2165 in)

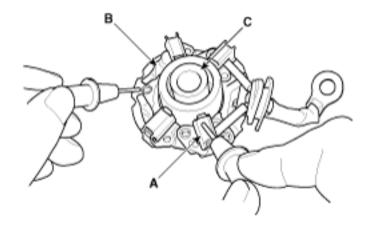


## NOTICE

• To seat new brushes, slip a strip of #500 or #600 sandpaper, with the grit side up, between the commutator and each brush, and smoothly rotate the armature. The contact surface of the brushes will be sanded to the same contour as the commutator.

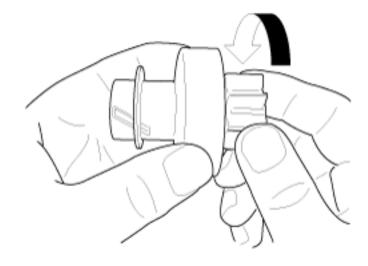
### **Starter Brush Holder**

1. Check that there is no continuity between the (+) brush holder (A) and (-) plate (B). If there is continuity, replace the brush holder assembly.



### **Overrunning Clutch**

- 1. Slide the overrunning clutch along the shaft. Replace it if does not slide smoothly.
- Rotate the overrunning clutch both ways.Does it lock in one direction and rotate smoothly in reverse? If it does not lock in either direction of it locks in both directions, replace it.



- 3. If the starter drive gear is worn or damaged, replace the overrunning clutch assembly. (the gear is not available separately)
  - Check the condition of the flywheel or torque converter ring gear if the starter drive gear teeth are damaged.

## **CLEANING**

- Do not immerse parts in cleaning solvent.
   Immersing the yoke assembly and/or armature will damage the insulation wipe these parts with a cloth only.
- 2. Do not immerse the drive unit in cleaning solvent.

  The overrun clutch is pre-lubricated at the factory and sol-vent will wash lubrication from the clutch.
- 3. The drive unit may be cleaned with a brush moistened with cleaning solvent and wiped dry with a cloth.

## **Engine Electrical System > Starting System > Starter > Specifications**

## **SPECIFICATION**

## Starter

Item		Specification	
Rated	12 V, 0.9 kW		
The number of pinion teeth		10	
Performance	Ampere	Max. 58A	
[No-load, 11.5 V]	Speed	Min. 3000 rpm	

### REFILLING AND BLEEDING

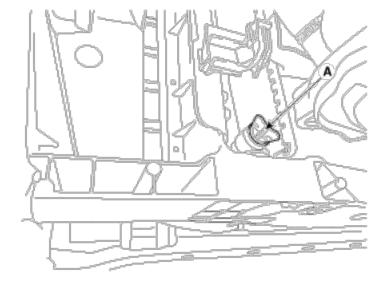
## **▲** WARNING

Never remove the radiator cap when the engine is hot. Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

## **▲** CAUTION

When pouring engine coolant, be sure to shut the relay box lid and not to let coolant spill on the electrical parts or the paint. If any coolant spills, rinse it off immediately.

- 1. Make sure the engine and radiator are cool to the touch.
- 2. Remove radiator cap.
- 3. Loosen the drain plug (A), and drain the coolant.



- 4. Tighten the radiator drain plug securely.
- 5. After draining engine coolant in the reservoir tank, clean the tank.
- 6. Fill the radiator with water through the radiator cap and tighten the cap.

## NOTICE

To most effectively bleed the air, pour the water slowly and press on the upper/lower radiator hoses.

- 7. Start the engine and allow to come to normal operating temperature. Wait for the cooling fans to turn on several times. Accelerate the engine to aid in purging trapped air. Shut engine off.
- 8. Wait until the engine is cool.
- 9. Repeat steps 1 to 8 until the drained water runs clear.
- 10. Fill fluid mixture with coolant and water (55~60%) (except for North America, Europe and China: 45~50%) slowly through the radiator cap. Push the upper/lower hoses of the radiator so as bleed air easily.

## NOTICE

• Use only genuine antifreeze/coolant.

- For best corrosion protection, the coolant concentration must be maintained year-round at 55% (except for North America, Europe and China: 45%) minimum.
   Coolant concentrations less than 55% (except for North America, Europe and China: 45%) may not provide sufficient protection against corrosion or freezing.
- Coolant concentrations greater then 60% will impair cooling efficiency and are not recommended.

### **▲** CAUTION

- Do not mix different brands of antifreeze/coolants.
- Do not use additional rust inhibitors or antirust products; they may not be compatible with the coolant.
- 11. Start the engine and run until coolant circulates.

  When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
- 12. Repeat 11 until the cooling fan 3~5 times and bleed air sufficiently out of the cooling system.
- 13. Install the radiator cap and fill the reservoir tank to the "MAX" (or "F") line with coolant.
- 14. Run the vehicle under idle until the cooling fan operates 2~3 times.
- 15. Stop the engine and wait coolant gets cool.
- 16. Repeat 10 to 15 until the coolant level doesn't fall any more, bleed air out of the cooling system.

### NOTICE

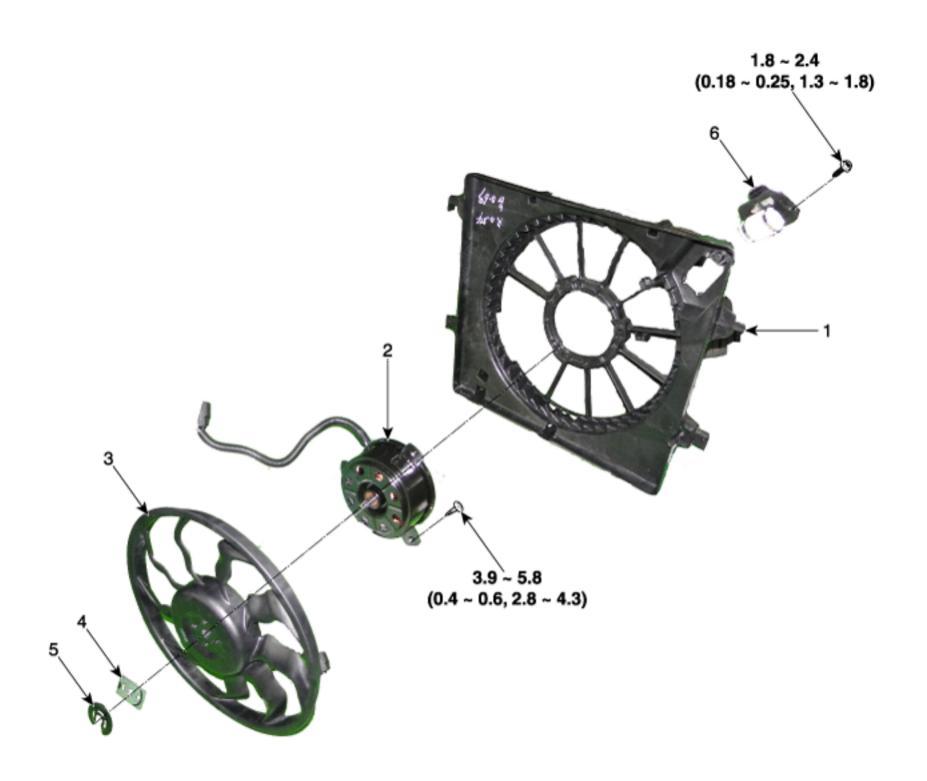
It takes time to bleed out all the air in the cooling system. Refill coolant when coolant gets cool completely, when recheck the coolant level in the reservoir tank for 2~3 days after replacing coolant.

### **Coolant capacity:**

MT : Approx. 4.9L (1.29 U.S.gal., 5.17 U.S.qt., 4.30 lmp.qt.)

AT: Approx. 4.8L (1.26 U.S.gal., 5.07 U.S.qt., 4.22 lmp.qt.)

## **COMPONENTS**



## Torque: N.m (kgf.m, lb-ft)

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- 2. Fan motor
- 3. Cooling fan

- 4. Torque washer
- 5. Retainer
- 6. Resistor

### **REMOVAL**

## Cooling fan assembly

- Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly "Engine Room Under Cover")
- 2. Disconnect the battery negative terminal.
- 3. Disconnect the cooling fan connector (A).



4. Remove the automatic transaxle fluid cooler hoses (A). [A/T type only]



5. Disconnect the mounting pin and then remove the cooling fan (A).



6. Install in the reverse order of removal.

### Resistor

1. Disconnect the wire harness connector (A) and the fan motor connector (B).



2. Remove the resistor (A) from the cooling fan shroud.

## Tightening torque:

1.8 ~ 2.4 N.m (0.18 ~ 0.25 kgf.m, 1.3 ~ 1.8 lb-ft)



3. Install in the reverse order of removal.

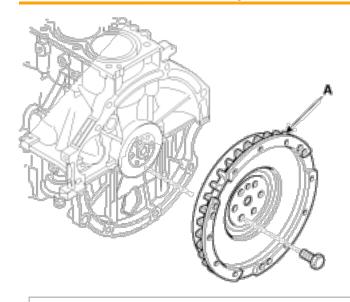
## Engine Mechanical System > Cylinder Block > Fly Wheel > Repair procedures

## **REMOVAL**

- Remove the manual Transaxle.
   (Refer to Manual Transaxle System "Manual Transaxle")
- 2. Remove the flywheel (A).

## Tightening torque:

68.6 ~ 78.5 N.m (7.0 ~ 8.0 kgf.m, 50.6 ~ 57.9 lb-ft)

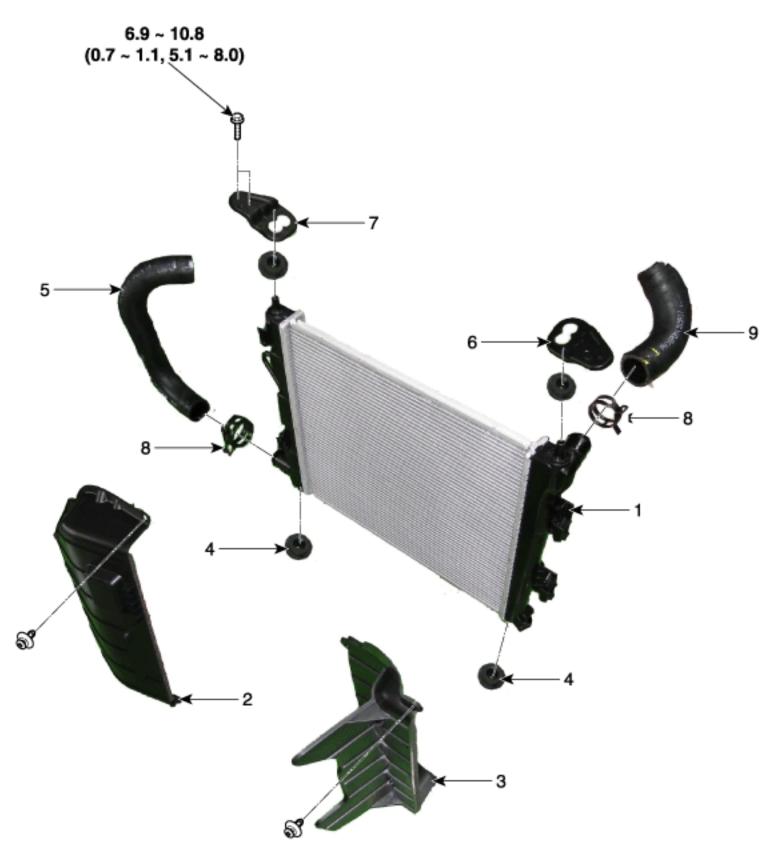


## NOTICE

Do not reuse the bolts.

3. Install in the reverse order of removal.

### **COMPONENTS**



Torque: N.m (kgf.m, lb-ft)

- 1. Radiator
- 2. Radiator air guard (LH)
- 3. Radiator air guard (RH)
- 4. Mounting insulator
- 5. Radiator lower hose

- 6. Radiator upper mounting bracket (RH)
- 7. Radiator upper mounting bracket (LH)
- 8. Clamp
- 9. Radiator upper hose

### **REMOVAL AND INSTALLATION**

## **▲** WARNING

Never remove the radiator cap when the engine is hot. Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

- Remove the cooling fan.
   (Refer to Cooling System "Cooling Fan")
- Drain the coolant.(Refer to Cooling System "Coolant")
- Remove the front bumper. (Refer to Body - "Front Bumper")
- 4. Remove the radiator upper hose (A) and the lower hose (B).





5. Remove the radiator upper cover (A).



6. Disconnect the air guard (A) and upper cover (B).



7. Remove the radiator upper mounting bracket (A).

## Tightening torque:

6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)



## NOTICE

Remove the radiator cap to speed draining.

8. Separate the condenser (A) from the radiator and then remove the radiator assembly (B).



- 9. Install in the reverse order of removal.
- 10. Fill the radiator with coolant and check for leaks.

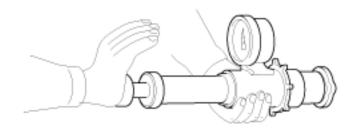
### NOTICE

- · Bleed air from the cooling system.
- Start engine and let it run until it warms up. (Until the radiator fan operates 3 or 4 times.)
- Turn off engine. Check the coolant level and add coolant if needed. This will allow trapped air to be removed from the cooling system.
- Put the radiator cap on tightly, then run engine again and check for leaks.

### **INSPECTION**

## Radiator Cap Testing

1. Remove the radiator cap, wet its seal with engine coolant, and then install it on a pressure tester.



- 2. Apply a pressure of 93.16~122.58kPa (0.95~1.25kgf/cm, 13.51~17.78psi).
- 3. Check for a drop in pressure.
- 4. If the pressure drops, replace the cap.

### Radiator Leakage Test

- 1. Wait until engine is cool, then carefully remove the radiator cap and fill the radiator with engine coolant, then install it on the pressure tester.
- 2. Apply a pressure tester to the radiator and apply a pressure of 93.16~122.58kPa (0.95~1.25kgf/cm, 13.51~17.78psi).



- 3. Inspect for engine coolant leaks and a drop in pressure.
- 4. Remove the tester and reinstall the radiator cap.

## NOTICE

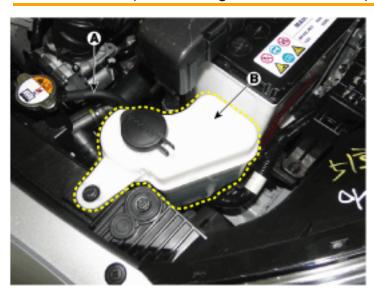
Check for engine oil in the coolant and/or coolant in the engine oil.

## **REMOVAL**

- 1. Disconnect the over flow hose (A).
- 2. Remove the reservoir tank (B).

## Tightening torque:

 $7.8 \sim 11.7 \text{ N.m} (0.8 \sim 1.2 \text{ kgf.m}, 5.7 \sim 8.6 \text{ lb-ft})$ 



3. Install in the reverse order of removal.

#### **REMOVAL AND INSTALLATION**

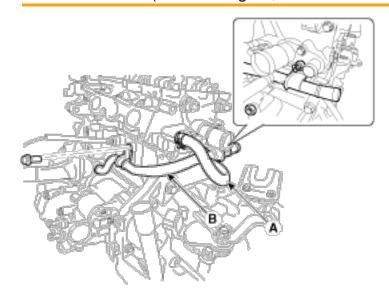
## **NOTICE**

Disassembly of the thermostat would have an adverse effect, causing a lowering of cooling efficiency.

- 1. Drain the engine coolant so its level is below thermostat.
- Disconnect the radiator lower hose.(Refer to Cooling System "Radiator")
- 3. Disconnect the heater hose.
- 4. Remove the intake manifold. (Refer to Intake and Exhaust System "Intake Manifold")
- 5. Disconnect the water hose (A) and then remove the heater pipe (B).

#### Tightening torque:

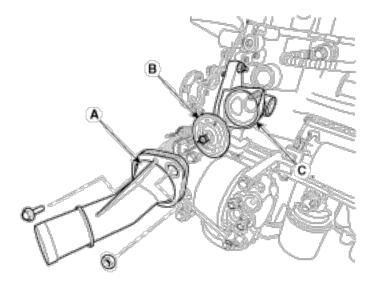
19.6 ~ 26.5 N.m (2.0 ~ 2.7 kgf.m, 14.5 ~ 19.5 lb-ft)



6. Remove the water inlet fitting (A), thermostat (B), thermostat housing (C).

#### **Tightening torque:**

18.6 ~ 23.5 N.m (1.9 ~ 2.4k gf.m, 13.7 ~ 17.4 lb-ft)



7. Installation is reverse order of removal.



- Install the thermostat with the jiggle valve upward.
- When assembling the thermostat, place the thermostat on the housing with a groove of the housing and install the gasket and inlet fitting. Be careful the thermostat doesn't get out of the groove on the housing.
- 8. Fill with engine coolant.
- 9. Start the engine and check for leaks.
- 10. Recheck the engine coolant level.

#### **INSPECTION**

1. Immerse the thermostat in water and gradually heat the water.



2. Check the valve opening temperature.

**Valve opening temperature :**  $88 \pm 1.5$ °C ( $190.4 \pm 2.7$ °F)

**Full opening temperature**: 100°C (212°F)

3. Check the valve lift.

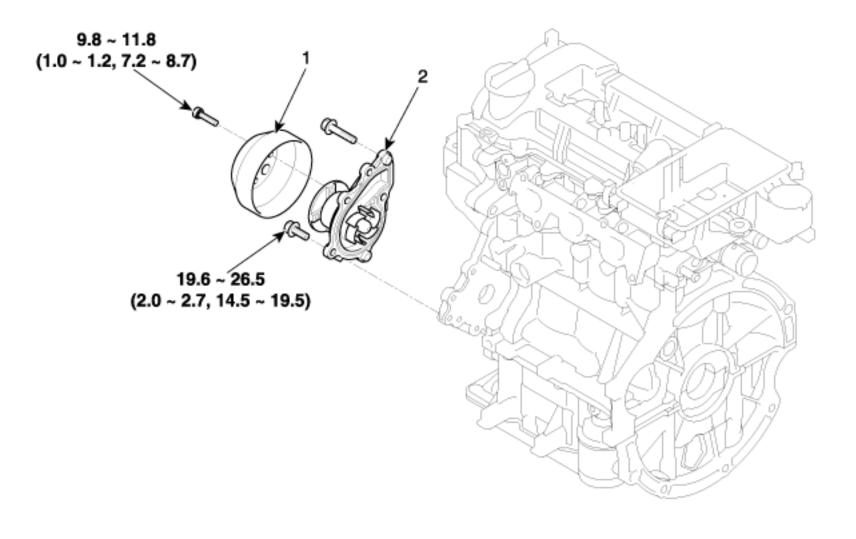
Valve lift: 8 mm (0.3 in) or more at 100°C (212°F)

# TROUBLESHOOTING

TROUBLESHOOTING				
Sym	ptoms	Poss	ible Causes	Remedy
Coolant leakage	From the thermostat	Check the mounting bolts	Check the torque of the mounting bolts	Retighten the bolts and check leakage again.
	gasket	Check the gasket for damage	Check gasket or seal for damage	<ul> <li>Replace gaskets and reuse the thermostat.</li> </ul>
Cooled excessively	<ul> <li>Low heater performance (cool air</li> </ul>	Visually check after removing the radiator cap.	Insufficient coolant or leakage.	After refilling coolant, recheck.
blowed-out)  • Thermogauge indicates 'LOW'		GDS check&Starting engine	<ul> <li>Check DTCs</li> <li>Check connection of the fan clutch or the fan motor.</li> <li>If the fan clutch is always connected, there will be a noise at idle.</li> </ul>	<ul> <li>Check the engine coolant sensor, wiring and connectors.</li> <li>Replace the componants.</li> </ul>
		Remove the thermostat and inspect	Check if there are dusts or chips in the thermostat valve.	<ul> <li>Clean the thermostat valve and reuse the thermostat.</li> </ul>
			Check adherence of the thermostat.	<ul> <li>Replace the thermostat, if it doesn't work properly.</li> </ul>
Heated excessively	Liigine		<ul> <li>Insufficient coolant or leakage.</li> <li>** Be careful when removing a radiator cap of the overheated vehicle.</li> <li>Check air in cooling system.</li> </ul>	<ul> <li>After refilling coolant, recheck.</li> <li>Check the cylinder head gaskets for damage and the tightening torque of the mounting bolts.</li> </ul>
		GDS check&Starting engine	<ul> <li>Check DTCs</li> <li>Check the fan motor performance as temperature varies.</li> <li>Check if the fan clutch slips.</li> <li>Check the water pump adherence or impeller damaged.</li> </ul>	<ul> <li>Check the engine coolant sensor, wiring and connectors.</li> <li>Check the fan motor, the relay and the connector.</li> <li>Replace the fan clutch, if it doesn't work properly.</li> <li>Replace the water pump, if it doesn't work properly.</li> </ul>

	Immerse the thermostat in boiling water and inspection.	<ul> <li>After removing the thermostat, check it works properly.</li> <li>* Check the thermostat opens at the valve opening temperature.</li> </ul>	<ul> <li>Replace the thermostat, if it doesn't work properly.</li> </ul>
<u> </u>			

## COMPONENTS



Torque : N.m(kgf.m, lb-ft)

1. Water pump pulley 2. Water pump

#### **REMOVAL AND INSTALLATION**

# **▲** WARNING

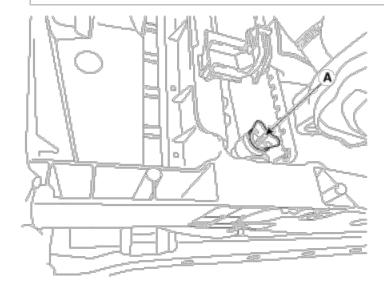
Never remove the radiator cap when the engine is hot.

Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

- 1. Disconnect the negative battery terminal.
- 2. Loosen the drain plug (A), and drain the coolant.

## NOTICE

Remove the radiator cap to speed draining.



3. Remove te drive belt. (Refer to Timing System - "Drive Belt")

4. Remove the idler (A) and water pump pulley (B).

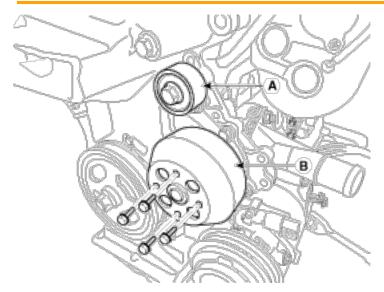
#### **Tightening torque**

Idler:

53.9 ~ 63.7 N.m (5.5 ~ 6.5 kgf.m, 39.8 ~ 47.0 lb-ft)

Water pump pulley:

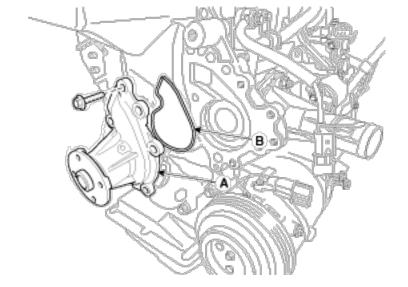
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



5. Remove the water pump (A) and O-ring (B).

#### **Tightening torque:**

19.6 ~ 26.5 N.m (2.0 ~ 2.7 kgf.m, 14.5 ~ 19.5 lb-ft)



## NOTICE

Always use a new O-ring.

- 6. Installation is reverse order of removal.
- 7. Install the drive belt.
- 8. Fill with engine coolant.
- 9. Start the engine and check for leaks.
- 10. Recheck the engine coolant level.

#### **INSPECTION**

- 1. Check each part for cracks, damage or wear, and replace the coolant pump assembly if necessary.
- 2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the coolant pump assembly if necessary.
- 3. Check for coolant leakage. If coolant leaks from hole, the seal is defective. Replace the coolant pump assembly.

## NOTICE

A small amount of "weeping" from the bleed hole is normal.

#### **TROUBLESHOOTING**

## **Water Pump**

Symptoms		Possible	Causes	Remedy
Coolant leakage	<ul> <li>From the bleed hole of the water pump</li> </ul>	Visually check	Check leaks after about ten-minute warming up.	If coolant still leaks,     replace a water pump.
				<ul> <li>If leakage stops, reuse the water pump (Do not replace the pump with a new one).</li> </ul>
	<ul> <li>From gaskets or bolts</li> </ul>		<ul> <li>Check the tightening of the water pump mounting bolts.</li> </ul>	Retighten the mounting bolts.
			<ul> <li>Check damage of gaskets or inflow of dust.</li> </ul>	Replace the gasket and clean dust off.
	From outer     surface of water     pump		Check the material or any cracks of the water pump.	Poor material. If any crack found, replace the water pump.
Noise	<ul><li>From bearings</li><li>From mechanical seals</li></ul>	Inspection with a stethoscope	After starting the engine, check noise with a	If there is no noise,     reuse the water pump     (do not replace it).
	Impeller interference		stethoscope.	<ul> <li>If there is any noise from the water pump, remove the drive belt and recheck.</li> </ul>
		Inspection after removing a drive belt	<ul> <li>After removing a water pump and a drive belt,</li> </ul>	If there is noise, reuse     the water pump. Check     other drive line parts.

# Damaged impeller

check noise again.

• If there is no noise, replace the water pump with a new one. If there is any

Inspection after removing a water pump

· After removing a water pump and a drive belt, check noise again.

pump with a new one.

interference between

them, replace the water

Overheating Loosened

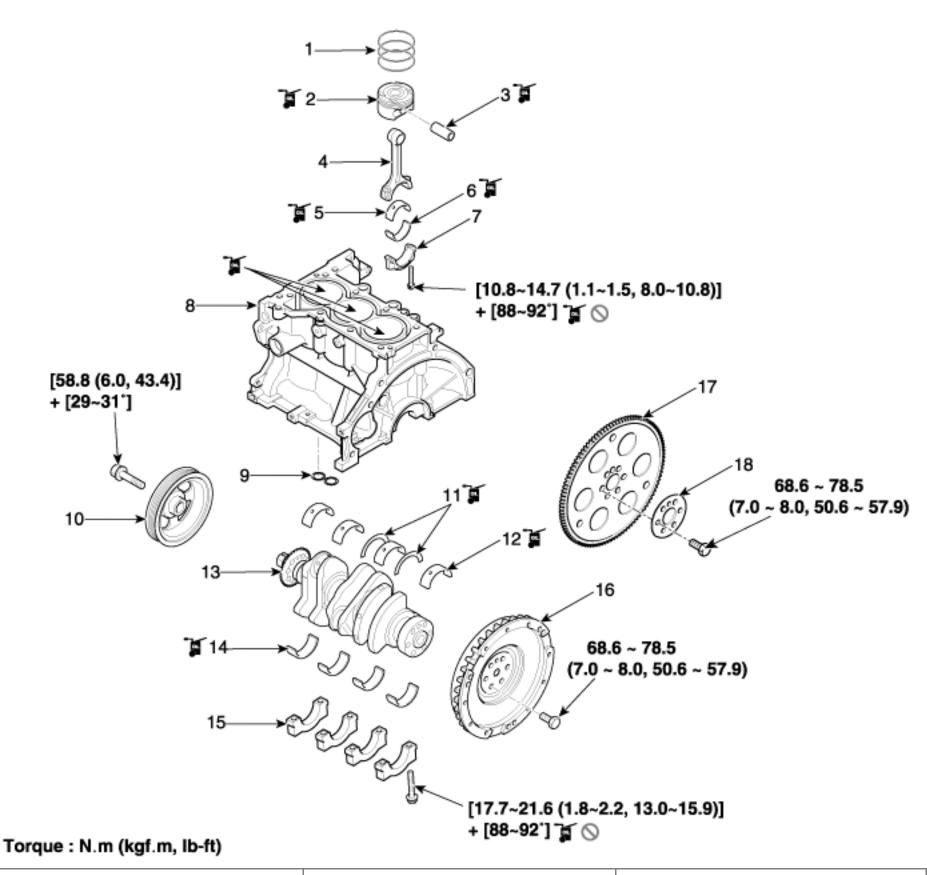
Loosened impeller

 Corrosion of the impeller wing

• Check engine coolant. Poor coolant quality / Maintenance check

impeller	Impeller     seperation from     the shaft	Replace the water pump.

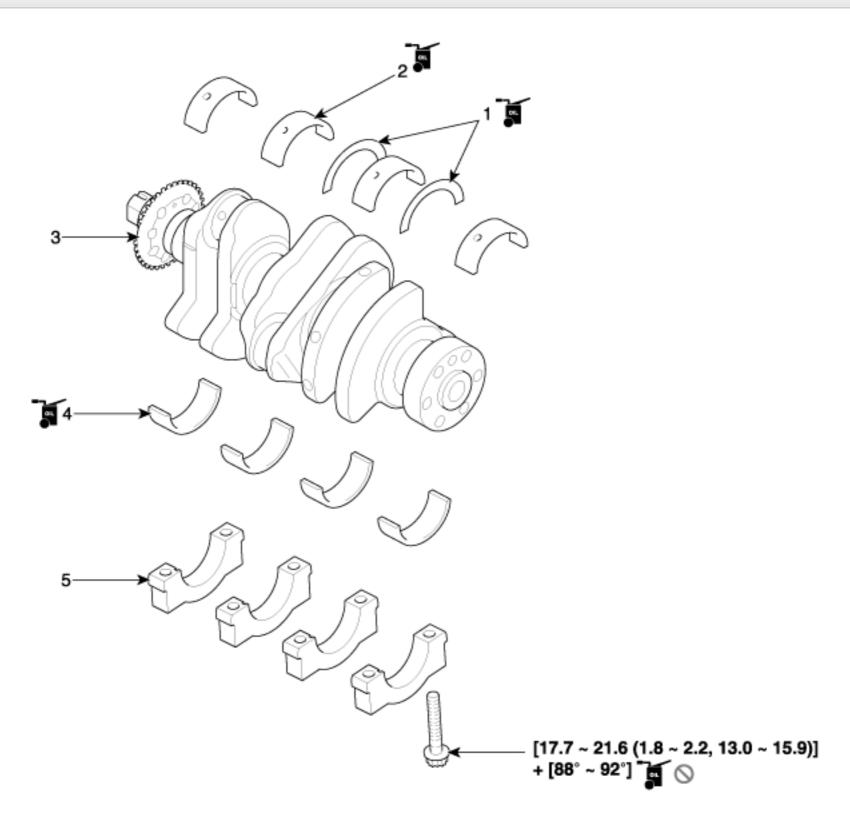
#### **COMPONENTS**



- 1. Piston ring
- 2. Piston
- 3. Piston pin
- 4. Connecting rod
- 5. Connecting rod bearing (Upper)
- 6. Connecting rod bearing (Lower)
- 7. Connecting rod cap
- 8. Cylinder block
- 9. O-ring
- 10. Crankshaft pulley
- 11. Thrust bearing
- 12. Main bearing (Upper)

- 13. Crankshaft
- 14. Main bearing (Lower)
- 15. Main bearing cap
- 16. Flywheel
- 17. Drive plate
- 18. Adapter plate

#### **COMPONENTS**



## Torque: N.m (kgf.m, lb-ft)

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- 2. Main bearing (Upper)
- 3. Crankshaft

- 4. Main bearing (Lower)
- 5. Main bearing cap

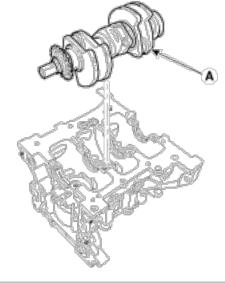
#### **DISASSEMBLY**

#### NOTICE

- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

#### i Information

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No.1 piston is at TDC (Top dead center).
- Remove the engine assembly from the vehicle.
   (Refer to Engine and Transaxle Assembly "Engine and Transaxle Assembly")
- Remove the transaxle assembly from the engine assembly.
   Manual Transaxle. (Refer to Manual Transaxle System "Manual Transaxle")
   Automatic Transaxle. (Refer to Automatic Transaxle System "Automatic Transaxle")
- 3. Manual Transaxle: Remove the flywheel. (Refer to Cylinder Block "Flywheel")
  Automatic Transaxle: Remove the drive plate. (Refer to Cylinder Block "Drive Plate")
- 4. Install the engine to engine stand for disassembly.
- 5. Remove the timing chain. (Refer to Timing System "Timing Chain")
- 6. Remove the intake manifold. (Refer to Intake and Exhaust System "Intake Manifold")
- 7. Remove the exhaust manifold. (Refer to Intake and Exhaust System "Exhaust Manifold")
- 8. Remove the cylinder head assembly.(Refer to Cylinder Head Assembly "Cylinder Head")
- 9. Remove the water pipe. (Refer to Cooling System "Water Pipe")
- 10. Remove the water temperature control assembly. (Refer to Cooling System "Water Temperature Control Assembly")
- 11. Remove the oil pan and oil screen. (Refer to Lubrication System "Oil Pan")
- Remove the ladder frame.
   (Refer to Cylinder Block "Cylinder Block")
- 13. Remove the piston and connecting rod assemblies. (Refer to Cylinder Block "Piston and Connecting Rod")
- 14. Remove the connecting rod caps and check oil clearance.
- 15. Check the crankshaft end play.
- 16. Remove the piston and connecting rod assemblies.



## NOTICE

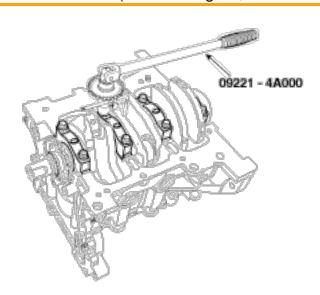
Arrange the piston rings in the correct order only.

#### **INSPECTION**

- 1. Check the crankshaft main bearing oil clearance.
  - (1) To check main bearing-to-journal oil clearance, remove the main bearings.
  - (2) Clean each main journal and bearing half with a clean shop tower.
  - (3) Place one strip of plastigage across each main journal.
  - (4) Use the SST (09221-4A000), reinstall the bearings and bolts as following method with specified torque. In the sequence.

#### **Tightening torque:**

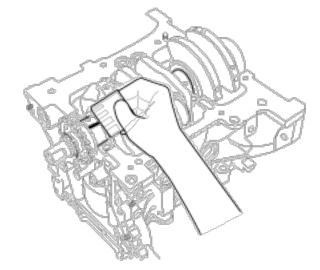
 $17.7 \sim 21.6 \text{ N.m} (1.8 \sim 2.2 \text{ kgf.m}, 13.0 \sim 15.9 \text{ lb-ft}) + 88^{\circ} \sim 92^{\circ}$ 



(5) Remove the cap and bearing again, and measure the widest part of the plastigage.

#### Standard oil clearance:

 $0.006 \sim 0.024 \text{ mm} (0.0002 \sim 0.0009 \text{ in})$ 



(6) If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

# **▲** CAUTION

Do not file, shim, or scrape the bearings or the caps to adjust clearance.

(7) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

## NOTICE

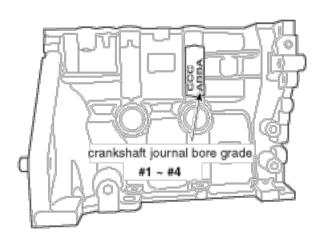
If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

# **▲** CAUTION

If the marks are indecipherable because of an accumulation of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.

## Cylinder block crankshaft journal bore mark location

Letters have been stamped on the block as a mark for the size of each of the 5 main journal bores. Use them, and the numbers or bar stamped on the crank (marks for main journal size), to choose the correct bearings.

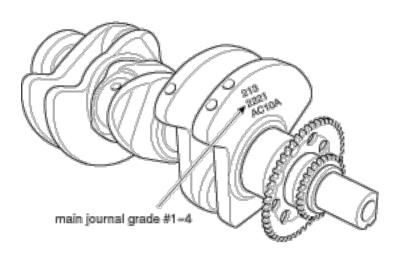


## Discrimination of Cylinder Block Crankshaft Journal Bore

Grade	Mark	Cylinder Block Crankshaft journal Bore Inner Diameter
а	А	52.000 ~ 52.006 mm (2.0472 ~ 2.0475 in)
		52.006 ~ 52.012 mm

b	В	(2.0475 ~ 2.0477 in)
С	С	52.012 ~ 52.018 mm (2.0477 ~ 2.0480 in)

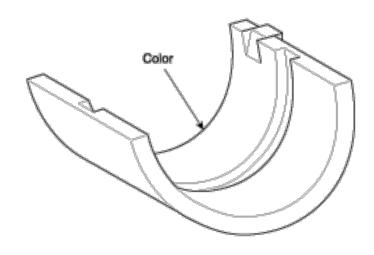
## **Crankshaft Main Journal Mark Location**



## **Discrimination of Crankshaft Main Journal**

Class	Mark	Crankshaft main journalouter diameter
1	1	47.954 ~ 47.960 mm (1.8880 ~ 1.8882 in)
II	2	47.948 ~ 47.954 mm (1.8877 ~ 1.8880 in)
III	3	47.942 ~ 47.948 mm (1.8875 ~ 1.8877 in)

# **Crankshaft Main Bearing Mark Location**



# **Discrimination of Crankshaft Main Bearing**

Mark	Color	Crankshaft Main Bearing Thickness
А	Blue	2.026 ~ 2.029 mm (0.0797 ~ 0.0798 in)
В	Black	2.023 ~ 2.026 mm (0.0796 ~ 0.0797 in)
С	None	2.020 ~ 2.023 mm (0.0795 ~ 0.0796 in)
D	Green	2.017 ~ 2.020 mm

		(0.0794 ~ 0.0795 in)
E	Yellow	2.014 ~ 2.017 mm (0.0793 ~ 0.0794 in)

(8) Select the bearing by using selection table.

## **Crankshaft Main Bearing Selection Table**

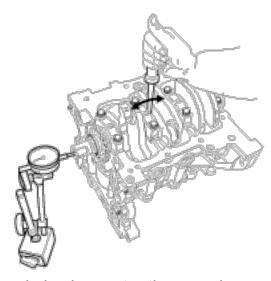
Crankshaft Main Bearing		Cylinder Block Crankshaft Journal Bore Mark				
Crankshall N	nam bearing	a (A)	b (B)	c (C)		
	I (1)	E(Yellow)	D(Green)	C(None)		
Crank shaft main journal mark	II (2)	D(Green)	C(None)	B(Black)		
journal mark	III (3)	C(None)	B(Black)	A(Blue)		

2. Check crankshaft end play.

Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

#### Standard end play:

 $0.05 \sim 0.25 \text{ mm} (0.0019 \sim 0.0098 \text{ in})$ 



If the end play is greater than maximum, replace the center bearings as a set.

#### Thrust bearing thickness:

 $1.925 \sim 1.975 \text{ mm} (0.0757 \sim 0.0777 \text{ in})$ 

#### Crankshaft end play:

 $0.05 \sim 0.25 \text{ mm} (0.0019 \sim 0.0098 \text{ in})$ 

3. Inspect the crankshaft main journals and pin journals.

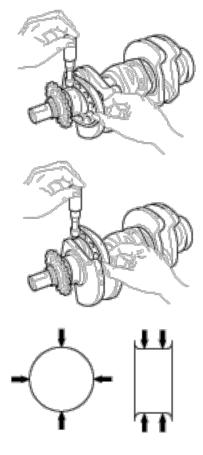
Using a micrometer, measure the diameter of each main journal and pin journal.

#### Main journal diameter :

47.942 ~ 47.960 mm (1.8874 ~ 1.8881 in)

## Pin journal diameter :

38.954 ~ 38.972 mm (1.5336 ~ 1.5343 in)



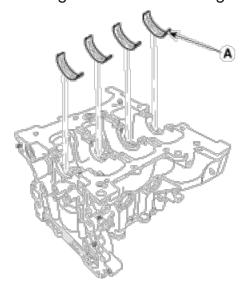
## **REASSEMBLY**

1. Install the crankshaft main bearings.

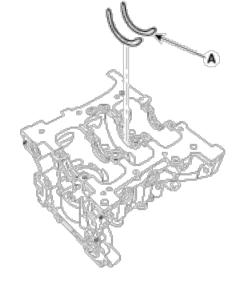
## NOTICE

Upper bearings have an oil groove of oil holes; Lower bearings do not.

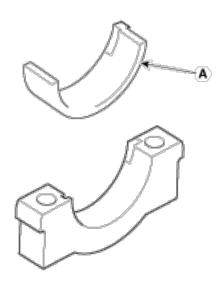
(1) Align the bearing claw with the claw groove of the cylinder block, push in the 5 (1.0L-4EA) upper bearings (A).



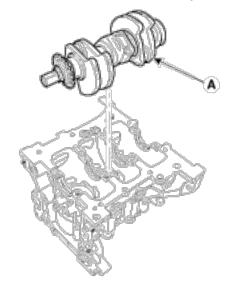
(2) Install the thrust bearings.
Install the 2 thrust bearings (A) under the No.3 journal position of the cylinder block with the oil grooves facing outward.



(3) Install the crankshaft lower main bearing (A).
Align the bearing claw with the groove of the crankshaft lower bearing and crankshaft main bearing cap.



2. Place the crankshaft (A) on the cylinder block.



3. Install the main bearing cap (A).

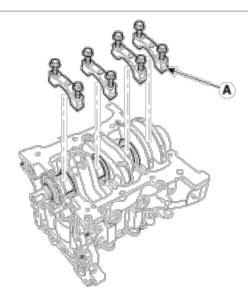
## NOTICE

- Always use new main bearing cap bolts.
- If any of the bearing cap bolts are broken or deformed, replace it.
- (1) Apply a light coat of engine oil on the threads and under the bearing cap bolts.
- (2) Install and uniformly tighten the 10 bearing cap bolts, in several passes.

#### **Tightening torque:**

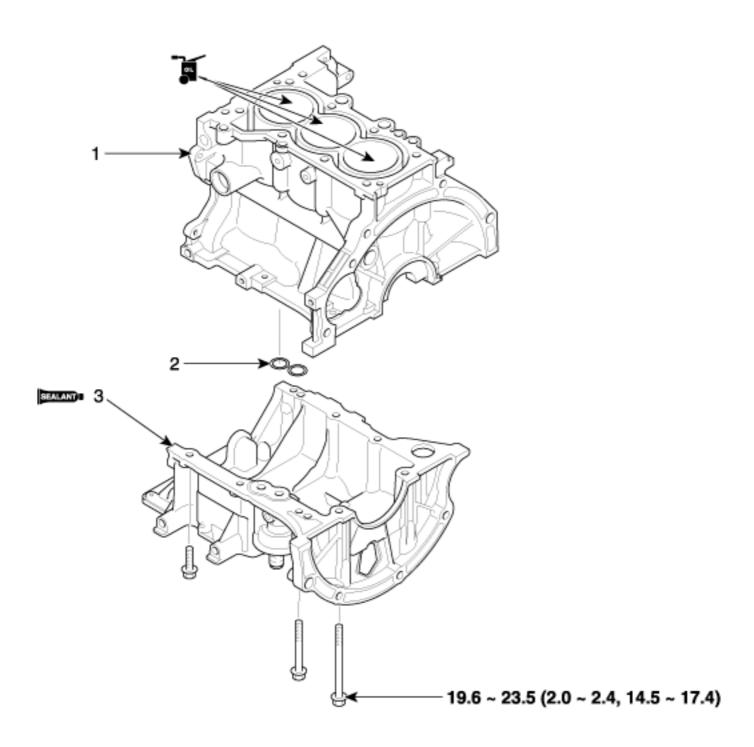
 $17.7 \sim 21.6 \text{ N.m} (1.8 \sim 2.2 \text{ kgf.m}, 13.0 \sim 15.9 \text{ lb-ft}) + 88^{\circ} \sim 92^{\circ}$ 

Using the SST (09221-4A000), tighten the bolts which need to be tightened with the angular tightening method.



- (3) Check that the crankshaft turns smoothly.
- 4. Check that the crankshaft end play.
- 5. Assemble the other parts in the reverse order of disassembly.

## **COMPONENTS**



# Torque : N.m (kgf.m, lb-ft)

1. Cylinder block	3. Ladder frame
2. O-ring	

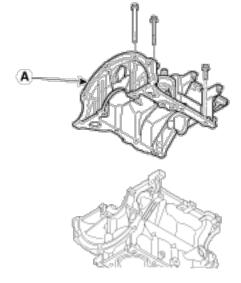
#### **DISASSEMBLY**

#### NOTICE

- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

## i Information

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No.1 piston is at TDC (Top dead center).
- Remove the engine assembly from the vehicle.
   (Refer to Engine and Transaxle Assembly "Engine and Transaxle Assembly")
- Remove the transaxle assembly from the engine assembly.
   Manual Transaxle. (Refer to Manual Transaxle System "Manual Transaxle")
   Automatic Transaxle. (Refer to Automatic Transaxle System "Automatic Transaxle")
- 3. Manual Transaxle: Remove the flywheel. (Refer to Cylinder Block "Flywheel")
  Automatic Transaxle: Remove the drive plate. (Refer to Cylinder Block "Drive Plate")
- 4. Install the engine to engine stand for disassembly.
- 5. Remove the timing chain. (Refer to Timing System "Timing Chain")
- 6. Remove the intake manifold. (Refer to Intake and Exhaust System "Intake Manifold")
- 7. Remove the exhaust manifold. (Refer to Intake and Exhaust System "Exhaust Manifold")
- 8. Remove the cylinder head assembly.(Refer to Cylinder Head Assembly "Cylinder Head")
- 9. Remove the water pipe. (Refer to Cooling System "Water Pipe")
- 10. Remove the water temperature control assembly. (Refer to Cooling System "Water Temperature Control Assembly")
- Remove the oil pan and oil screen.
   (Refer to Lubrication System "Oil Pan")
- 12. Remove the ladder frame (A).
  Insert the blade of SST (09215-3C000) between the cylinder block and the ladder frame. Cut off applied sealer and remove the ladder frame.



- 13. Remove the piston and connecting rod assemblies. (Refer to Cylinder Block "Piston and Connecting Rod")
- Remove the crankshaft.
   (Refer to Cylinder Block "Crankshaft")

#### **INSPECTION**

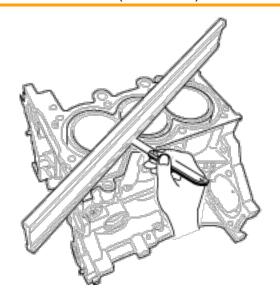
## Cylinder Block

- Remove the gasket material.
   Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.
- Clean the cylinder block.
   Using a soft brush and solvent, thoroughly clean the cylinder block.
- Inspect the top surface of the cylinder block for flatness.
   Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

#### Flatness of cylinder block gasket surface

Standard: Less than 0.05 mm (0.002 in),

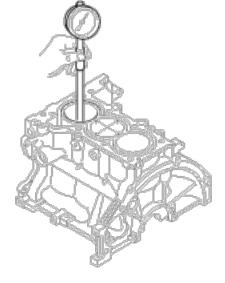
Less than 0.02 mm (0.0008 in) / 100 x 100 (3.937 x 3.937 in)



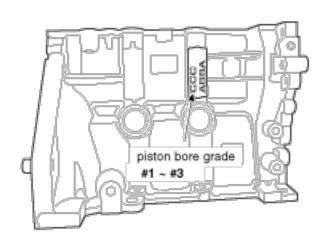
- Inspect the cylinder bore.
   Visually check the cylinder for vertical scratchs.
   If deep scratchs are present, replace the cylinder block.
- 5. Inspect the cylinder bore diameter.
  Using a cylinder bore gauge, measure the cylinder bore diameter at position in the thrust and axial direction.

#### Standard diameter:

 $71.00 \sim 71.03 \text{ mm} (2.7952 \sim 2.7964 \text{ in})$ 



6. Check the cylinder bore size code on the cylinder block.

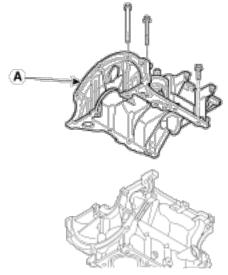


## Discrimination of cylinder bore size

Grade	Size code	Cylinder Bore inner Diameter
а	А	71.00 ~ 71.01 mm (2.7952 ~ 2.7956 in)
b	В	71.01 ~ 71.02 mm (2.7956 ~ 2.7960 in)
С	С	71.02 ~ 71.03 mm (2.7960 ~ 2.7964 in)

## **REASSEMBLY**

- Remove the crankshaft.
   (Refer to Cylinder Block "Crankshaft")
- Remove the piston and connecting rod assemblies.
   (Refer to Cylinder Block "Piston and Connecting Rod")
- 3. Install the ladder frame (A).

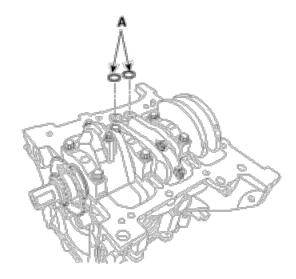


(1) Using a gasket scraper, remove all the old packing material.

## NOTICE

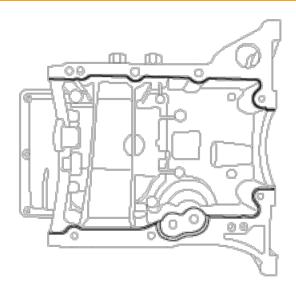
Be careful not to damage the contact surfaces.

(2) Install the O-ring (A) to cylinder block.



(3) Before assembling the ladder frame, the liquid sealant TB1217H should be applied on ladder frame. The part must be assembled within 5minutes after the sealant was applied.

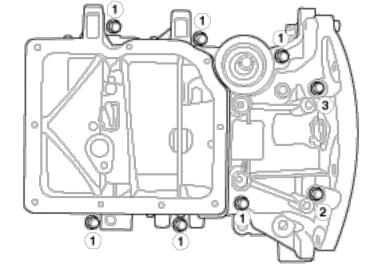
**Bead width :**  $2.5 \sim 3.5 \text{ mm}$  (0.1  $\sim 0.14 \text{ in}$ )



(4) Install and uniformly tighten the ladder frame bolts, in several passes.

#### **Tightening torque:**

19.6 ~ 23.5 N.m (2.0 ~ 2.4 kgf.m, 14.5 ~ 17.4 lb-ft)



4. Assemble the other parts in the reverse order of disassembly.

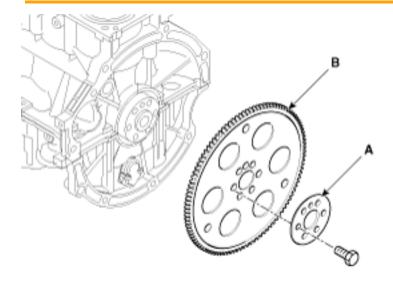
## Engine Mechanical System > Cylinder Block > Drive Plate > Repair procedures

## **REMOVAL**

- Remove the automatic transaxle.
   (Refer to Automatic Transaxle System "Automatic Transaxle")
- 2. Remove the drive plate (A) and the adapter plate (B).

## Tightening torque:

68.6 ~ 78.5 N.m (7.0 ~ 8.0 kgf.m, 50.6 ~ 57.9 lb-ft)

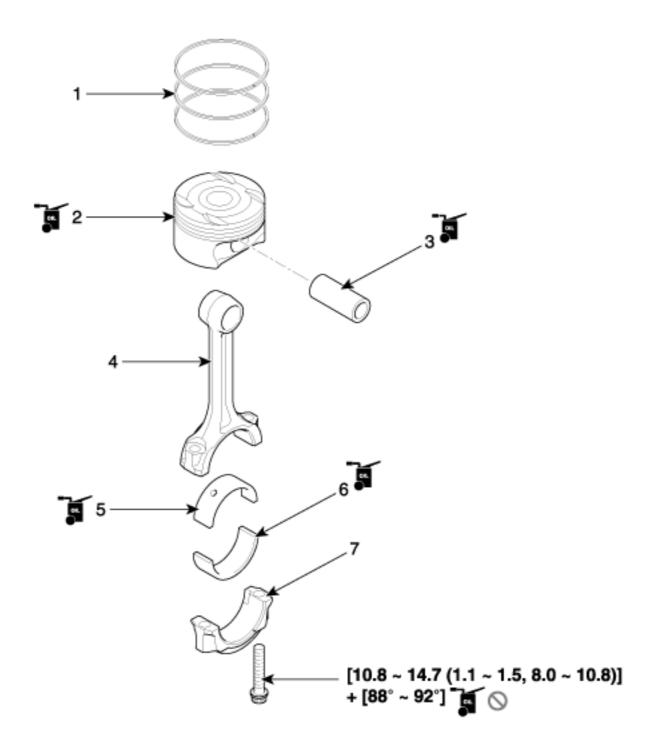


# NOTICE

Do not reuse the bolts.

3. Install in the reverse order of removal.

#### **COMPONENTS**



## Torque: N.m (kgf.m, lb-ft)

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			$\cdot$			. 4

- 2. Piston
- 3. Piston pin
- 4. Connecting rod

- 5. Connecting upper bearing
- 6. Connecting lower bearing
- 7. Connecting cap

#### **DISASSEMBLY**

#### NOTICE

- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

## i Information

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No.1 piston is at TDC (Top dead center).
- Remove the engine assembly from the vehicle.
   (Refer to Engine and Transaxle Assembly "Engine and Transaxle Assembly")
- 2. Remove the transaxle assembly from the engine assembly.

  Manual Transaxle. (Refer to Manual Transaxle System "Manual Transaxle")

  Automatic Transaxle. (Refer to Automatic Transaxle System "Automatic Transaxle")
- 3. Manual Transaxle: Remove the flywheel. (Refer to Cylinder Block "Flywheel")
  Automatic Transaxle: Remove the drive plate. (Refer to Cylinder Block "Drive Plate")
- 4. Install the engine to engine stand for disassembly.
- 5. Remove the timing chain. (Refer to Timing System "Timing Chain")
- 6. Remove the intake manifold. (Refer to Intake and Exhaust System "Intake Manifold")
- 7. Remove the exhaust manifold. (Refer to Intake and Exhaust System "Exhaust Manifold")
- 8. Remove the cylinder head assembly.(Refer to Cylinder Head Assembly "Cylinder Head")
- 9. Remove the water pipe. (Refer to Cooling System "Water Pipe")
- 10. Remove the water temperature control assembly. (Refer to Cooling System "Water Temperature Control Assembly")
- 11. Remove the oil pan and oil screen. (Refer to Lubrication System "Oil Pan")
- Remove the ladder frame.
   (Refer to Cylinder Block "Cylinder Block")
- 13. Check the connecting rod end play.
- 14. Remove the connecting rod caps and check oil clearance.
- 15. Check the connecting rod cap oil clearance.
- 16. Remove the piston and connecting rod assemblies.
  - (1) Using a ridge reamer, remove all the carbon from the top of the cylinder.

- (2) Remove the connecting rod cap.
- (3) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

## NOTICE

- Keep the bearings, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in the correct order.
- 17. Check fit between piston and piston pin.
  Try to move the piston back and forth on the piston pin. If any movement is felt, replace piston and piston pin as a set.
- 18. Remove the piston rings.
  - (1) Using a piston ring expander, remove the 2 compression rings.
  - (2) Remove 2 side rails and the spacer by hand.

# NOTICE

Arrange the piston rings in the correct order only.

19. Remove the connecting rod from the piston.
Using a press, remove the piston pin from the piston.

**Press-in load**: 250 ~ 1050 kg (551 ~ 2315 lb)

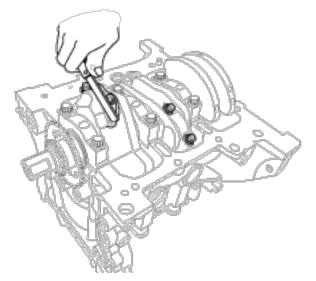
#### **INSPECTION**

## **Connecting Rod**

Check the connecting rod end play.
 Using a feeler gauge, measure the end play while moving the connecting rod back and forth.

#### Standard end play:

 $0.10 \sim 0.25 \text{ mm} (0.0039 \sim 0.0098 \text{ in})$ 

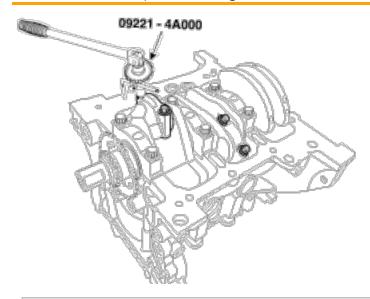


- (1) If out-of-tolerance, install a new connecting rod.
- (2) If still out-of-tolerance, replace the crankshaft.
- 2. Check the connecting rod bearing oil clearance.
  - (1) Check the match marks on the connecting rod and cap are aligned to ensure correct reassembly.

- (2) Remove the 2 connecting rod cap bolts.
- (3) Remove the connecting rod cap and lower bearing.
- (4) Clean the crank pin journal and bearing.
- (5) Place a plastigage across the crankshaft pin journal.
- (6) Reinstall the lower bearing and cap, and tighten the bolts.

#### Tightening torque:

 $10.8 \sim 14.7 \text{ N.m} (1.1 \sim 1.5 \text{ kgf.m}, 8.0 \sim 10.8 \text{ lb-ft}) + 88^{\circ} \sim 92^{\circ}$ 



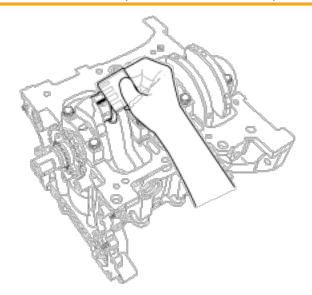
#### NOTICE

Do not turn the crankshaft.

- (7) Remove the 2 bolts, connecting rod cap and lower bearing.
- (8) Measure the plastigage at its widest point.

#### Standard oil clearance

 $0.018 \sim 0.036 \text{ mm} (0.0007 \sim 0.0014 \text{ in})$ 



(9) If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark (Refer to connecting rod bearing selection table)

Recheck the oil clearance.



Do not file, shim, or scrape the bearings or the caps to adjust clearance.

(10) If the plastigage shows the clearance is still incorrect, try the next lager or smaller bearing. (Refer to connecting rod bearing selection table Recheck the oil clearance.

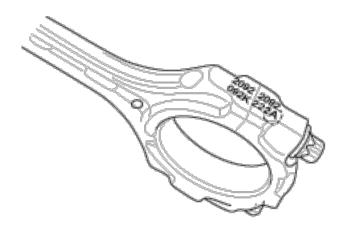


If the proper clearance cannot be obtained by using the appropriate lager or smaller bearings, replace the crankshaft and start over.

# **▲** CAUTION

If the alignment marks are unreadable because of an accumulation of grease or grime, don't clean with a wire or abrasive cleaner. Clean only with correct cleaning solvent or detergent.

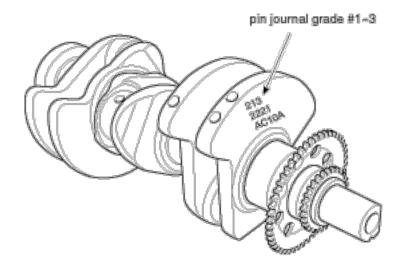
# **Connecting Rod Mark Location**



## **Discrimination of Connecting Rod**

Grade	Mark	Connecting Rod Big-end Inner Diameter
0	А	42.000 ~ 42.006 mm (1.6535 ~ 1.6540 in)
1	В	42.006 ~ 42.012 mm (1.6537 ~ 1.6540 in)
2	С	42.012 ~ 42.018 mm (1.6540 ~ 1.6542 in)

## **Crankshaft Pin Journal Mark Location**

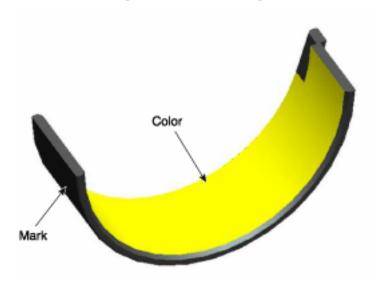


## **Discrimination of Crankshaft Pin Journal**

Class	Mark	Crankshaft Pin Journal outer Diameter
I	1	38.966 ~ 38.972 mm (1.5340 ~ 1.5343 in)
II	2	38.960 ~ 38.966 mm

		(1.5338 ~ 1.5340 in)
III	3	38.954 ~ 38.960 mm (1.7698 ~ 1.7701 in)

# **Connecting Rod Bearing Mark Location**



# **Discrimination of Connecting Rod Bearing**

Grade	Color	Connecting Rod Bearing Thickness
А	Blue	1.514 ~ 1.517 mm (0.0596 ~ 0.0597 in)
В	Black	1.511 ~ 1.514 mm (0.0595 ~ 0.0596 in)
С	None	1.508 ~ 1.511 mm (0.0594 ~ 0.0595 in)
D	Green	1.505 ~ 1.508 mm (0.0593 ~ 0.0594 in)
Е	Yellow	1.502 ~ 1.505 mm (0.0591 ~ 0.0593 in)

(11) Select the bearing by using selection table.

## **Connecting Rod Bearing Selection Table**

Connecting Rod Bearing		Connecting Rod Mark		
		0 (A)	1 (B)	2 (C)
Crank shaft pin journal mark	I (1)	E (Yellow)	D (Green)	C (None)
	II (2)	D (Green)	C (Red)	B (Black)
	III (3)	C (None)	B (Black)	A (Blue)

#### **Piston**

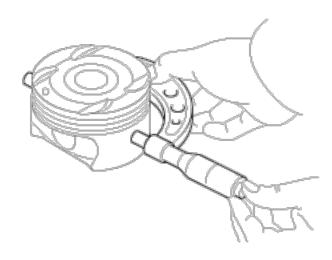
- 1. Clean the piston
  - (1) Using a gasket scraper, remove the carbon from the piston top.
  - (2) Using a groove cleaning tool, clean the piston ring grooves.
  - (3) Using solvent and a brush, thoroughly clean the piston.

Do not use a wire brush.

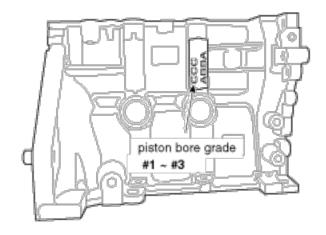
2. The standard measurement of the piston outside diameter is taken 30mm (1.18in) from top of the piston.

#### Standard diameter

70.970 ~ 71.000 mm (2.7940 ~ 2.7952i n)



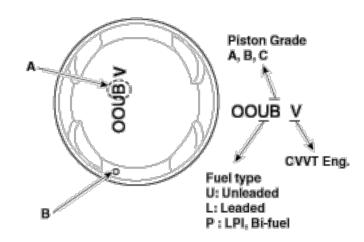
3. Check the cylinder bore size code on the cylinder block.



## Discrimination of cylinder bore size

Grade	Size code	Cylinder Bore inner Diameter
а	А	71.00 ~ 71.01 mm (2.7952 ~ 2.7956 in)
b	В	71.01 ~ 71.02 mm (2.7956 ~ 2.7960 in)
С	С	71.02 ~ 71.03 mm (2.7960 ~ 2.7964 in)

4. Check the piston size code (A) and the front mark (B) on the piston top face.



#### **Discrimination of Piston Outer Diameter**

Grade	Size code	Piston Outer Diameter
а	А	70.970 ~ 70.980 mm (2.7940 ~ 2.7944 in)
b	В	70.980 ~ 70.990 mm (2.7944 ~ 2.7948 in)
С	С	70.990 ~ 71.000 mm (2.7948 ~ 2.7952 in)

5. Select the piston related to cylinder bore class.

**Clearance :** 0.02 ~ 0.04 mm (0.0008 ~ 0.0016 in)

# Piston Rings

1. Calculate the difference between the cylinder bore diameter and the piston diameter.

#### **Piston-to-cylinder clearance:**

 $0.02 \sim 0.04 \text{ mm} (0.0008 \sim 0.0016 \text{ in})$ 

2. Inspect the piston ring side clearance.

Using a feeler gauge, measure the clearance between new piston ring and the wall of the ring groove.

#### Piston ring groove width

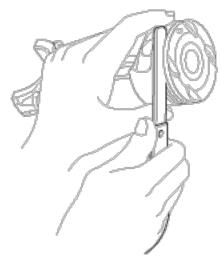
No.1 : 1.03 ~ 1.05 mm (0.0405 ~ 0.0413 in) No.2 : 1.23 ~ 1.25 mm (0.0484 ~ 0.0492 in) Oil ring : 2.01 ~ 2.025 mm (0.0791 ~0.0797 in)

**Piston ring width** 

No.1: 0.97~ 0.985 mm (0.0381 ~ 0.0387 in) No.2: 1.17 ~ 1.19 mm (0.0460 ~ 0.0468 in) Oil ring: 1.91 ~ 1.97 mm (0.0751 ~ 0.0775 in)

Piston ring side clearance

No.1: 0.04 ~ 0.08 mm (0.0015 ~ 0.0031 in) No.2: 0.04 ~ 0.08 mm (0.0015 ~ 0.0031 in) Oil ring: 0.04 ~ 0.115 mm (0.0015 ~0.0045 in)



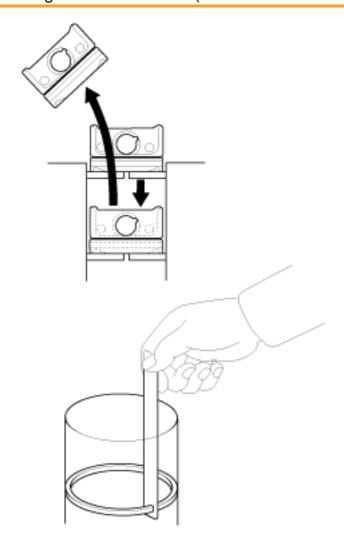
If the clearance is greater than maximum, replace the piston.

#### 3. Inspect piston ring end gap.

To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring. If the gap is too large, recheck the cylinder bore diameter against the wear limits. If the bore is over the service limit, the cylinder block must be replaced.

#### Piston ring end gap

No.1 :  $0.13 \sim 0.25$  mm  $(0.0051 \sim 0.0098$  in) No.2 :  $0.30 \sim 0.45$  mm  $(0.0118 \sim 0.0177$  in) Oil ring :  $0.10 \sim 0.40$  mm  $(0.0039 \sim 0.0157$  in)



#### **Piston Pins**

1. Measure the diameter of the piston pin.

#### Piston pin outer diameter:

18.000 ~ 18.003 mm (0.7086 ~ 0.7087 in)

#### Piston pin hole diameter:

18.013 ~ 18.017 mm (0.7091 ~ 0.7093 in)

#### Connecting rod small end inner diameter:

17.974 ~ 17.985 mm (0.7076 ~ 0.7080 in)



2. Measure the piston pin-to-piston clearance.

#### Piston pin-to-piston clearance:

 $0.010 \sim 0.017 \text{ mm} (0.0004 \sim 0.0006 \text{ in})$ 

3. Check the difference between the piston pin outer diameter and the connecting rod small end inner diameter.

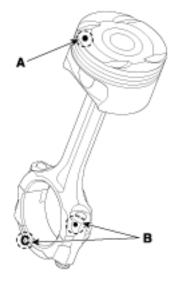
#### Piston pin-to-connecting rod interference:

 $0.015 \sim 0.029 \text{ mm} (0.0006 \sim 0.0014 \text{ in})$ 

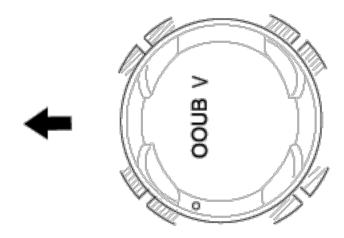
#### REASSEMBLY

#### NOTICE

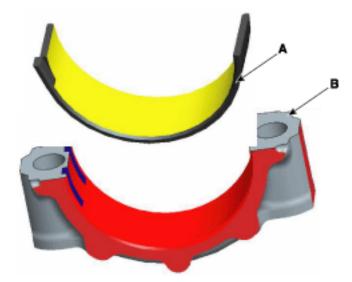
- · Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.
- 1. Assemble the piston and connecting rod.
  - (1) Use a hydraulic press for installation.
  - (2) The piston front mark (A) and the connecting rod front mark (B) must face the timing belt side of the engine.



- 2. Install the piston rings.
  - (1) Install the oil ring expender and 2 side rails by hand.
  - (2) Using a piston ring expender, install the 2 compression rings with the code mark facing upward.
  - (3) Position the piston rings so that the ring ends are as shown.



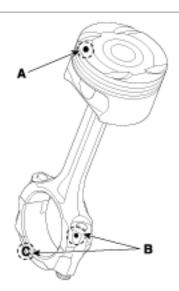
- 3. Install the connecting rod bearings.
  - (1) Align the bearing claw with the groove of the connecting rod and connecting rod cap.
  - (2) Install the bearings (A) in the connecting rod and connecting rod cap (B).



4. Install the piston and connecting rod assemblies.

#### NOTICE

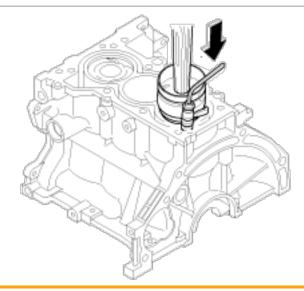
- Before installing the pistons, apply a coat of engine oil to the ring grooves and cylinder bores.
- The piston front mark (A) and the connecting rod front mark (B) must face the timing chain side of the engine.



- (1) Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.
- (2) Stop after the ring compressor pops free, and check the connecting rod to check journal alignment before pushing the piston into place.
- (3) Apply engine oil to the bolt threads. Install the rod caps with bearings, and tighten the bolts.

### NOTICE

- · Always use new connecting rod bearing cap bolts.
- Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.

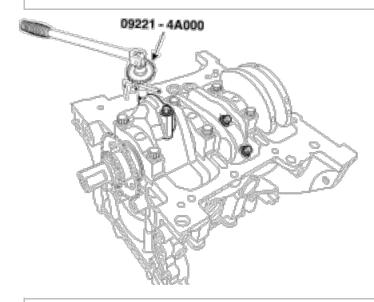


#### **Tightening torque:**

 $10.8 \sim 14.7 \text{ N.m} (1.1 \sim 1.5 \text{ kgf.m}, 8.0 \sim 10.8 \text{ lb-ft}) + 88^{\circ} \sim 92^{\circ}$ 

### NOTICE

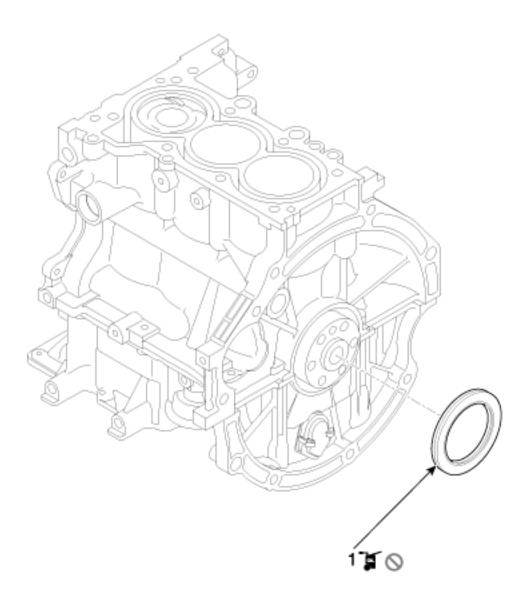
Using the SST (09221-4A000), tighten the bolts which need to be tightened with the angular tightening method.



### NOTICE

- Do not reuse the connecting rod cap bolts.
- Maintain downward force on the ring compressor to prevent the rings from expending before entering the cylinder bore.
- 5. Check the connecting rod end play.
- 6. Assemble the other parts in the reverse order of disassembly.

# **COMPONENTS**



Torque : N.m (kgf.m, lb-ft)

1. Rear oil seal

#### **REMOVAL**

1. Remove the automatic transaxle.

(Refer to Automatic Transaxle System - "Automatic Transaxle")

Remove the manual transaxle.

(Refer to Manual Transaxle System - "Manual Transaxle")

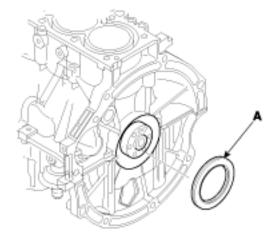
2. Automatic transaxle : Remove the drive plate.

(Refer to Cylinder Block - "Drive Plate")

Manual transaxle : Remove the flywheel.

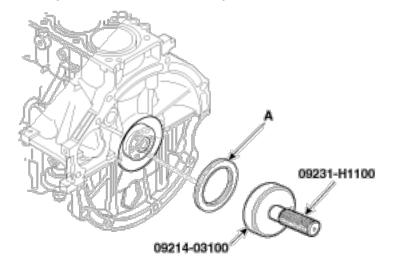
(Refer to Cylinder Block - "Flywheel")

3. Remove the rear oil seal (A).



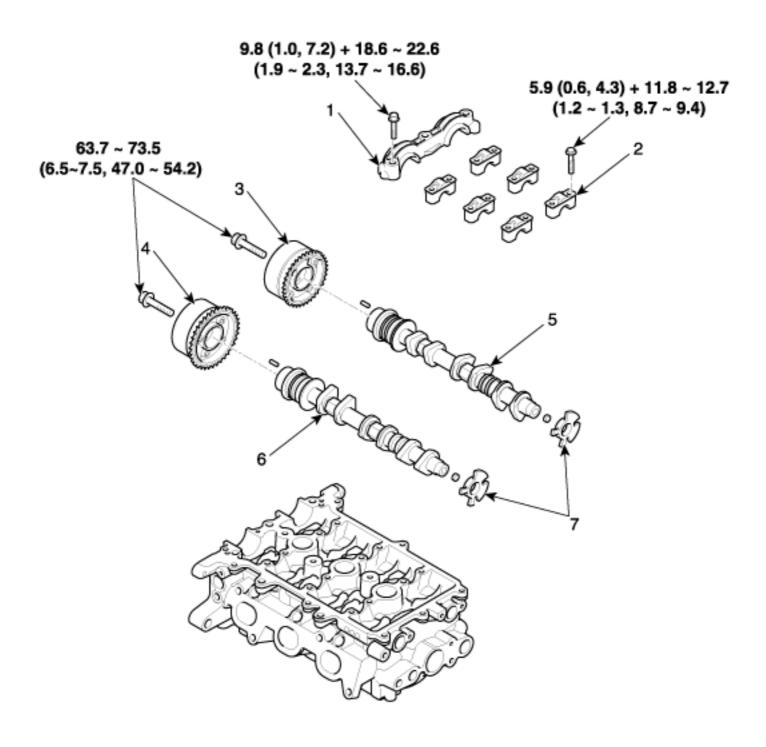
#### **INSTALLATION**

- 1. Install a new rear oil seal.
  - (1) Apply engine oil on the edge of new oil seal.
  - (2) Using SST (09231-H1100, 09214-03100) and a hammer, tap in the oil seal (A) until the SST face is aligned with the cylinder block assembly rear face.



2. Install the other parts reverse order of removal.

#### **COMPONENTS**



### Torque: N.m(kgf.m, lb-ft)

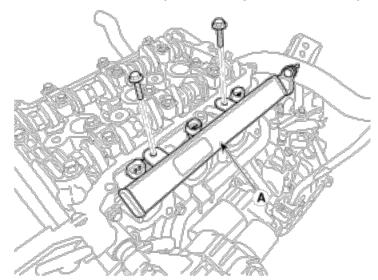
- 1. Front camshaft bearing cap
- 2. Camshaft bearing cap
- 3. Exhause CVVT
- 4. Intake CVVT

- 5. Exhause camshaft
- 6. Intake camshaft
- 7. Sensor target wheel

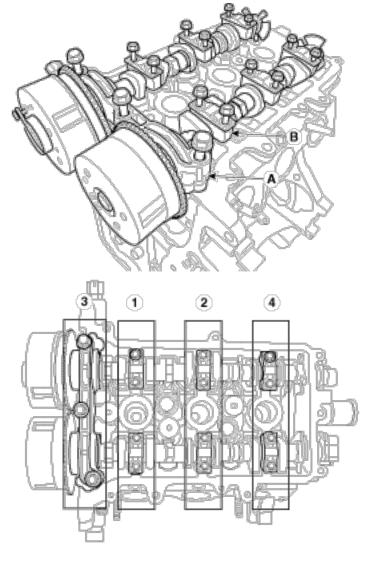
# Engine Mechanical System > Cylinder Head Assembly > CCVT & Camshaft > Repair procedures

# **REMOVAL**

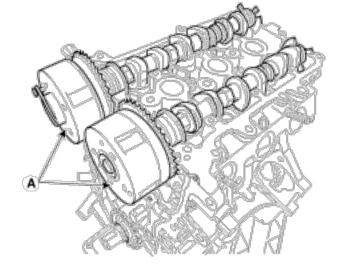
- Remove the timing chain.
   (Refer to Timing System "Timing Chain")
- 2. Remove the delivery pipe & injector assembly (A).



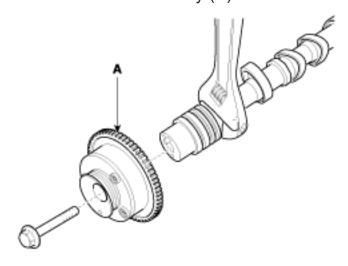
3. Remove the front camshaft bearing cap (A) and the camshaft bearing caps (B) in the sequence shown.



4. Remove the cam shafts (A).



5. Remove the CVVT assembly (A) from the camshaft.



#### **INSPECTION**

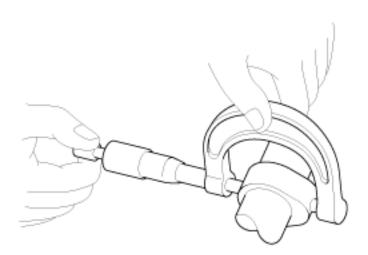
### Cylinder Head

1. Inspect cam lobes.

Using a micrometer, measure the cam lobe height.

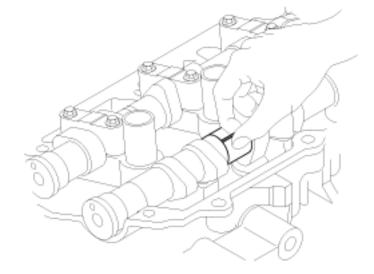
#### Cam height

Intake: 40.79833 mm (1.6062 in) Exhaust: 40.39819 mm (1.5905 in)



If the cam lobe height is less than standard, replace the camshaft.

- 2. Inspect the camshaft journal clearance.
  - (1) Clean the bearing caps and camshaft journals.
  - (2) Place the camshafts on the cylinder head.
  - (3) Lay a strip of plastigage across each of the camshaft journals.



(4) Install the front camshaft bearing cap (A) and the camshaft bearing cap (B) as following method with specified torque.

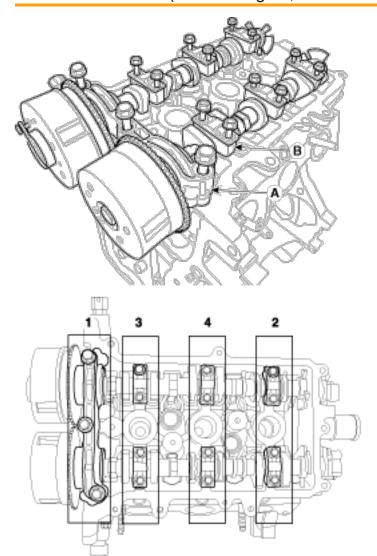
#### **Tightening torque**

Step 1

A: 9.8 N.m (1.0 kgf.m, 7.2 lb-ft) B: 5.9 N.m (0.6 kgf.m, 4.3 lb-ft)

Step 2

A: 18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft) B: 11.8 ~ 12.7 N.m (1.2 ~ 1.3 kgf.m, 8.7 ~ 9.4 lb-ft)



### **NOTICE**

Do not turn the camshaft.

- (5) Remove the bearing caps.
- (6) Measure the plastigage at its widest point.

#### Camshaft bearing oil clearance

Intake:  $0.027 \sim 0.057 \text{ mm} (0.0010 \sim 0.0022 \text{ in})$ 

Exhaust:  $0.027 \sim 0.057 \text{ mm} (0.0010 \sim 0.0022 \text{ in})$ 

#### Camshaft journal outer diameter

Intake / Exhaust No.1:

36.464 ~ 36.478 mm (1.4356 ~ 1.4361 in)

Intake / Exhaust No.2 ~ 5:

20.964 ~ 20.978 mm (0.8254 ~ 0.8259 in)

#### Camshaft journal bore inner diameter

Intake / Exhaust No.1:

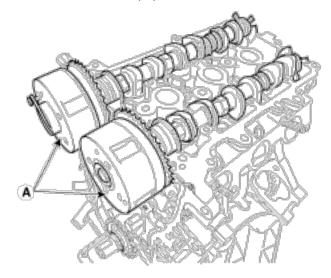
36.505 ~ 36.521 mm (1.4372 ~ 1.4378 in)

Intake / Exhaust No.2 ~ 5:

21.005 ~ 21.021 mm (0.8269 ~ 0.8275 in)

If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

- (7) Completely remove the plastigage.
- (8) Remove the camshafts.
- 3. Inspect the camshaft end play.
  - (1) Install the camshafts (A).



(2) Install the front camshaft bearing cap (A) and the camshaft bearing cap (B) as following method with specified torque.

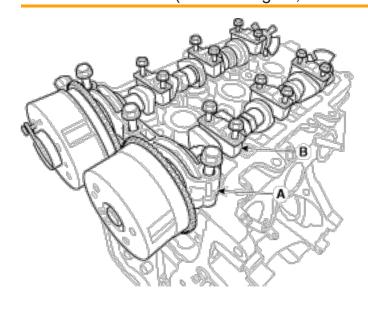
#### **Tightening torque**

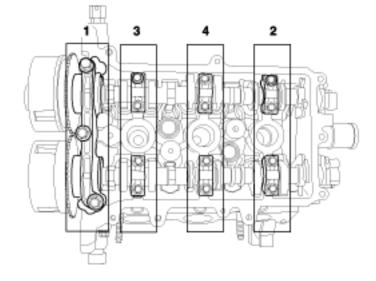
Step 1

A: 9.8 N.m (1.0 kgf.m, 7.2 lb-ft) B: 5.9 N.m (0.6 kgf.m, 4.3 lb-ft)

Step 2

A: 18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft) B: 11.8 ~ 12.7 N.m (1.2 ~ 1.3 kgf.m, 8.7 ~ 9.4 lb-ft)





### NOTICE

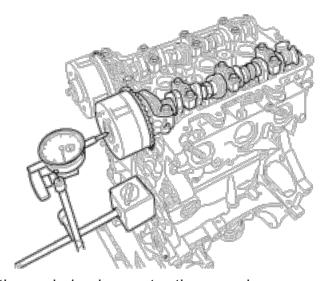
Do not turn the camshaft.

When cam caps are installed, arrows on the top of caps must point to out side of engine.

(3) Using a dial indicator, measure the end play while moving the camshaft back and forth.

#### Camshaft end play:

Intake :  $0.1 \sim 0.2 \text{ mm} (0.0039 \sim 0.0078 \text{ in})$ Exhaust :  $0.1 \sim 0.2 \text{ mm} (0.0039 \sim 0.0078 \text{ in})$ 

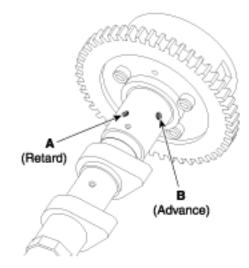


If the end play is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

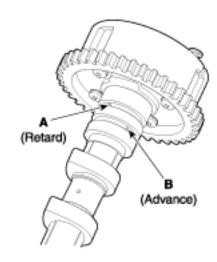
(4) Remove the camshafts.

### **CVVT Assembly**

- 1. Inspect CVVT assembly.
  - (1) Clamp the camshaft using a vise. Be careful not to damage the cam lobes and journals in the vise.
  - (2) Check that the CVVT is locked by turning it clockwise or counterclockwise. It must not rotate.
  - (3) Intake CVVT: Seal one of the two advance holes in the camshaft journal with tape. Exhaust CVVT: Seal one of the two retard holes in the camshaft journal with tape. [Intake]



#### [Exhaust]



(4) Intake CVVT : Apply approx. 150kPa (1.5kgf/cm, 21psi) of compressed air into the unsealed advance hole to

Exhaust CVVT : Apply approx. 150kPa (1.5kgf/cm, 21psi) of compressed air into the unsealed retard hole to release the lock.



Cover the oil paths with a piece of cloth when applying compressed air to prevent oil from spraying.

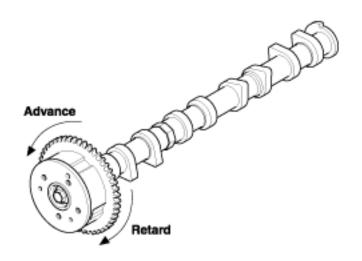
(5) Intake CVVT: With compressed air applied, rotate the CVVT into the advance direction (counterclockwise) within its phasing range and check that the CVVT turns smoothly.

Exhaust CVVT: With compressed air applied, rotate the CVVT into the retard direction (clockwise) and check that the CVVT turns smoothly.

#### **CVVT** phasing range

Intake: 25° ± 1° (from the most retarded position to the most advanced position)

Exhaust : 20° ± 1° (from the most advanced position to the most retarded position)



(6) Intake CVVT: Rotate the CVVT into the most retarded position (clockwise) and then check that the CVVT is locked.

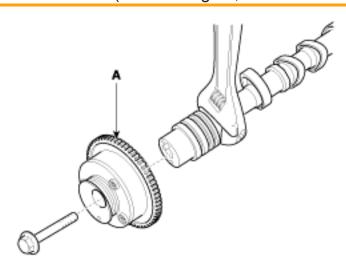
Exhaust CVVT : Rotate the CVVT into the most advanced position (counterclockwise) and then check that the CVVT is locked.

# **INSTALLATION**

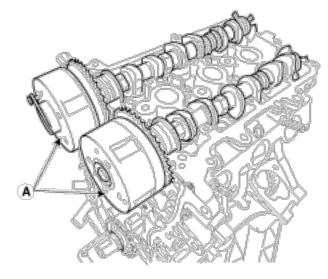
1. Install the CVVT assembly (A) to the camshaft.

#### **Tightening torque:**

63.7 ~ 73.5 N.m (6.5 ~ 7.5 kgf.m, 47.0 ~ 54.2 lb-ft)



2. Install the cam shafts (A).



3. Install the front camshaft bearing cap (A) and the camshaft bearing caps (B) as following method with specified torque.

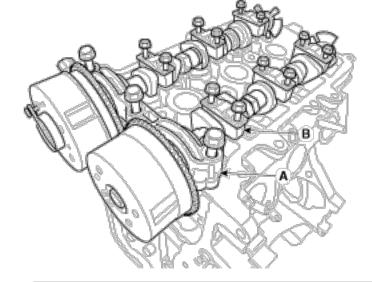
#### **Tightening torque:**

1st step

A: 9.8 N.m (1.0 kgf.m, 7.2 lb-ft) B: 5.9 N.m (0.6 kgf.m, 4.3 lb-ft)

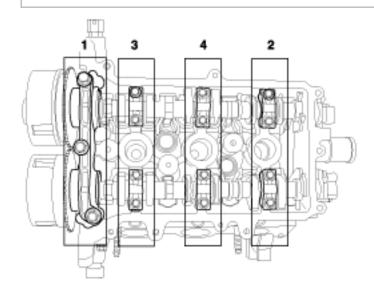
2nd step

A: 18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft) B: 11.8 ~ 12.7 N.m (1.2 ~ 1.3 kgf.m, 8.7 ~ 9.4 lb-ft)



# NOTICE

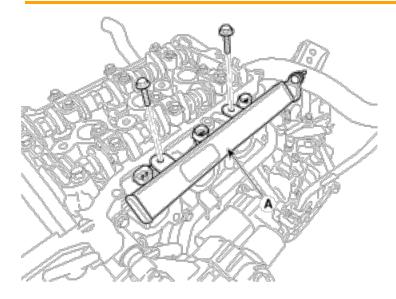
Arrow on the top of cap must to outside of engine.



4. Install the delivery pipe (A).

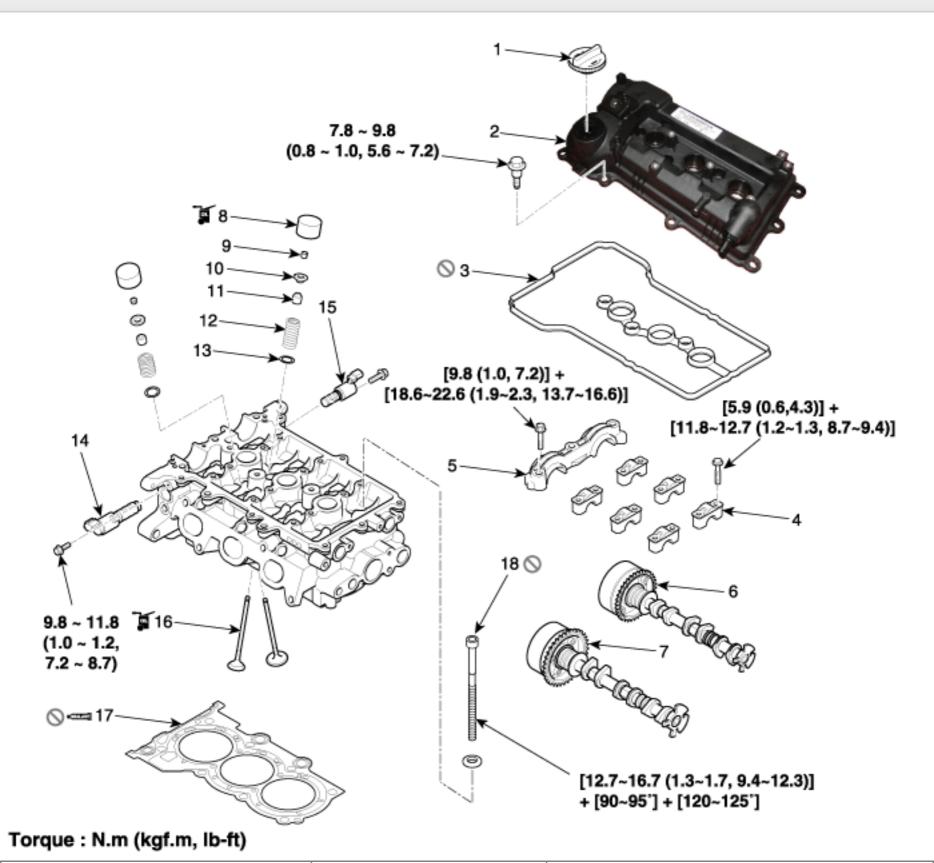
### Tightening torque:

18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)



5. Install the other parts in the reverse order of removal.

#### **COMPONENTS**

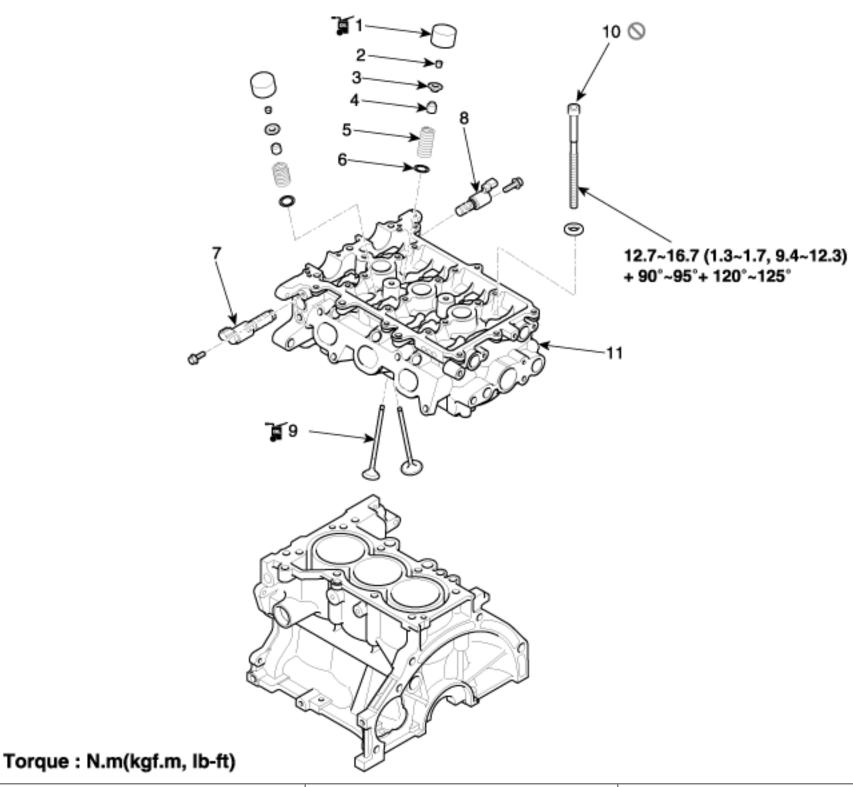


- 1. Oil filler cap
- 2. Cylinder head cover
- 3. Cylinder head cover gasket
- 4. Camshaft bearing cap
- 5. Front camshaft bearing cap
- 6. Exhaust CVVT assembly

- 7. Intake CVVT assembly
- 8. MLA (Mechanical Lash Adjuster)
- 9. Retainer lock
- 10. Retainer
- 11. Valve stem seal
- 12. Valve spring

- 13. Valce spring seat
- 14. Intake OCV (Oil control valve)
- 15. Exhaust OCV (Oil control valve)
- 16. Valve
- 17. Cylinder head gasket
- 18. Cylinder head bolt

#### **COMPONENTS**



- 1. MLA (Mechanical Lash Adjuster)
- 2. Retainer lock
- 3. Retainer
- 4. Valve stem seal

- 5. Valve spring
- 6. Valce spring seat
- 7. Intake OCV (Oil control valve)
- 8. Exhaust OCV (Oil control valve)
- 9. Valve
- 10. Cylinder head bolt
- 11. Cylinder head

#### **REMOVAL**

Engine removal is not required for this procedure.

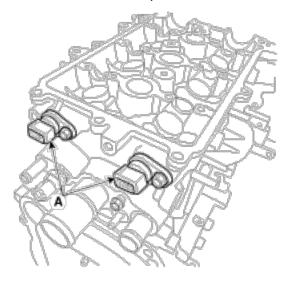
### **▲** CAUTION

- · Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature (20°C [68°F]) before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

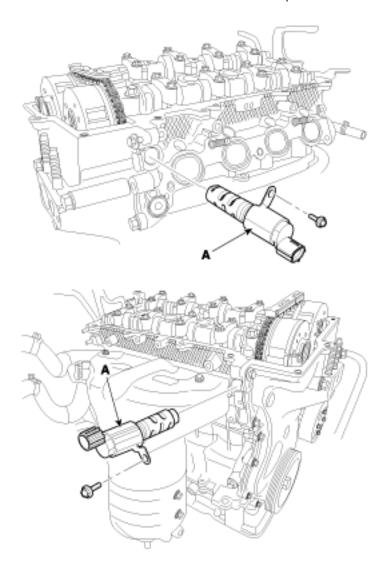
#### NOTICE

- · Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.
- Remove the Battery.
   (Refer to Engine Electrical System "Battery")
- Remove the air cleaner assembly. (Refer to Intake and Exhaust System - "Air Cleaner")
- Remove the battery tray.
   (Refer to Engine Electrical System "Battery")
- Remove the engine room under cover and side covers.
   (Refer to Engine and Transaxle Assembly "Engine Room Under Cover")
- Drain the coolant. (Refer to Cooling System - "Coolant")
- Remove the cylinder head cover.(Refer to Cylinder Head Assembly "Cylinder Head Cover")
- Remove the timing chain.(Refer to Timing System "Timing Chain")
- Remove the exhaust manifold.
   (Refer to Intake and Exhaust System "Exhaust Manifold")
- Remove the intake manifold.
   (Refer to Intake and Exhaust System "Intake Manifold")
- Remove the camshaft.
   (Refer to Cylinder Head Assembly "CVVT & Camshaft")
- Remove the ignition coil.
   (Refer to Engine Electrical System "Ignition Coil")
- Remove the delivery pipe & injector assembly (A).
   (Refer to Fuel System "Injector")

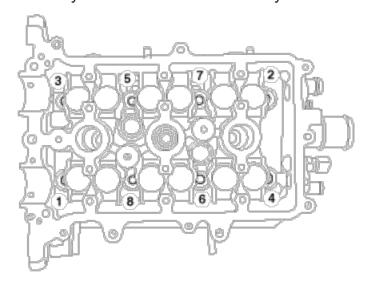
13. Remove the Intake CMPS (Camshaft Position Sensor) (A).



14. Remove the intake / exhaust OCV (Oil control valve) (A).



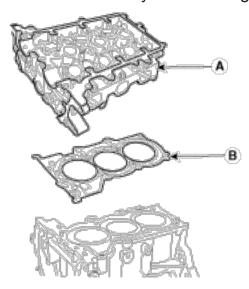
15. Uniformly loosen and remove the cylinder head bolts, in several passes, in the sequence shown.



# NOTICE

Head warpage or cracking could result from removing bolts in an incorrect order.

16. Lift the cylinder head (A) from the dowels on the cylinder block and place the cylinder head on wooden blocks on a bench. and remove the cylinder head gasket (B).



### NOTICE

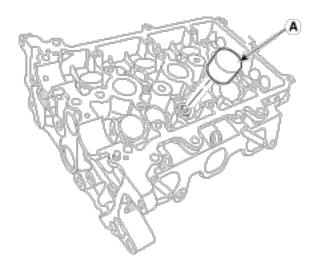
Be careful not to damage the contact surfaces of the cylinder head and cylinder block.

#### **DISASSEMBLY**

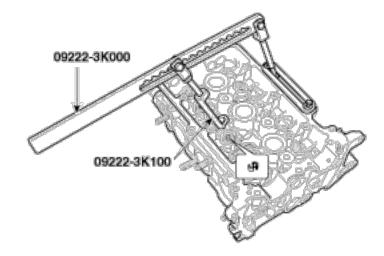
### NOTICE

Identify MLA (Mechanical Lash Adjuster), valves, valve springs as they are removed so that each item can be reinstalled in its original position.

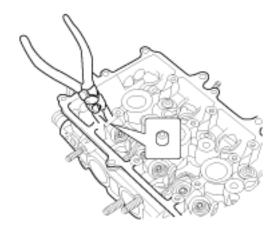
1. Remove the mechanical lash adjuster (A).



- 2. Remove the valves.
  - (1) Using the SST (09222-3K000, 09222-3K100), press the valve spring and remove retainer lock.



- (2) Remove the spring retainer.
- (3) Remove the valve spring.
- (4) Remove the valve.
- (5) Using the pliers remove the valve stem seal.



### NOTICE

Do not reuse old valve stem seals.

#### **INSPECTION**

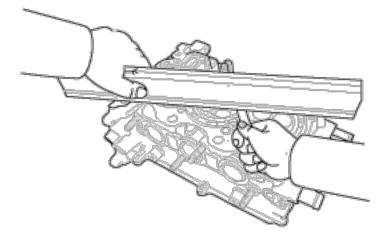
# Cylinder Head

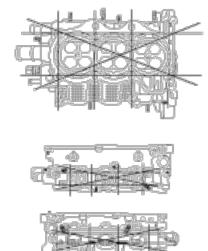
1. Inspect for flatness.

Using a precision straight edge and feeler gauge, measure the surface contacting cylinder block and the manifolds for warpage.

#### Flatness of cylinder head gasket surface

Standard: Less than 0.05 mm (0.0020 in) Less than 0.02 mm (0.0008 in) / 100 x 100 Flatness of manifold gasket surface Standard: Less than 0.1 mm (0.0039 in)





2. Inspect for cracks.

Check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.

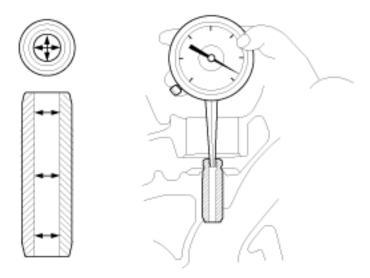
### Valve and Valve Spring

- 1. Inspect valve stems and valve guides.
  - (1) Using a caliper gauge, measure the inside diameter of the valve guide.

#### Valve guide I.D.

Intake / Exhaust :

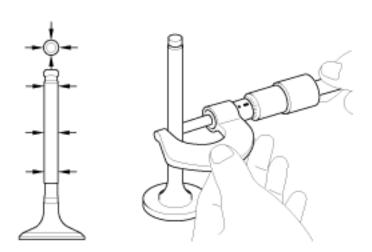
5.500 ~ 5.512 mm (0.2165 ~0.2170 in)



(2) Using a micrometer, measure the diameter of the valve stem.

#### Valve stem O.D.

Intake :  $5.465 \sim 5.480 \text{ mm} (0.2151 \sim 0.2157 \text{ in})$ Exhaust :  $5.448 \sim 5.460 \text{ mm} (0.2144 \sim 0.2149 \text{ in})$ 



(3) Subtract the valve stem diameter measurement from the valve guide inside diameter measurement.

#### Valve stem-to-guide clearance

Intake: 0.020 ~ 0.047 mm (0.00078 ~ 0.00185 in)

Exhaust :0.040  $\sim$  0.064 mm (0.00157  $\sim$  0.00251 in)

#### 2. Inspect valves.

(1) Check the valve is ground to the correct valve face angle.

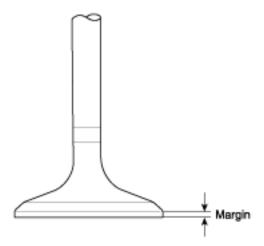
#### Valve face angle:

Intake/Exhaust: 45.25° ~ 45.75°

- (2) Check that the surface of the valve for wear. If the valve face is worn, replace the valve.
- (3) Check the valve head margin thickness. If the margin thickness is less than minimum, replace the valve.

#### Margin

Intake: 1.5 mm (0.0590 in) Exhaust: 1.75 mm (0.0688 in)



(4) Check the valve length.

#### Length

Intake: 92.85 mm (3.6555 in) Exhaust: 93.37 mm (3.6759 in)

- (5) Check the surface of the valve stem tip for wear. If the valve stem tip is worn, replace the valve.
- 3. Inspect valve seats.
  - (1) Check the valve seat for evidence of overheating and improper contact with the valve face. If the valve seat is worn, replace cylinder head.
  - (2) Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace cylinder head.
  - (3) Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.

#### Valve seat contact width:

Intake :  $0.85 \sim 1.15$  mm (  $0.0334 \sim 0.0452$  in) Exhaust :  $1.35 \sim 1.65$  mm ( $0.0531 \sim 0.0649$  in)

Valve seat angle:

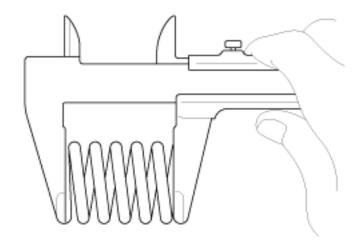
Intake / Exhaust : 44.75° ~ 45.10°

- 4. Inspect valve springs.
  - (1) Using a steel square, measure the out-of-square of the valve spring.
  - (2) Using vernier calipers, measure the free length of the valve spring.

#### Valve spring

Free height: 47.9 mm (1.8858 in)

Out-of-square: 1.5° (MAX)



### MLA (Mechanical Lash Adjuster)

1. Inspect the MLA.

Using a micrometer, measure the MLA outside diameter.

#### **MLA** outside diameter

Intake/Exhaust:

27.965 ~ 27.980 mm (1.1010 ~ 1.1016 in)

2. Using a caliper gauge, masure MLA tappet bore inner diameter of cylinder head.

#### Tappet bore inner diameter

Intake/Exhaust:

28.000 ~ 28.025 mm (1.1024 ~ 1.1033 in)

3. Subtract MLA outside diameter measurement from tappet bore inside diameter measurement.

#### **MLA** to tappet bore clearance

[Limit]

Intake/Exhaust:

 $0.020 \sim 0.060 \text{ mm} (0.0008 \sim 0.0024 \text{ in})$ 

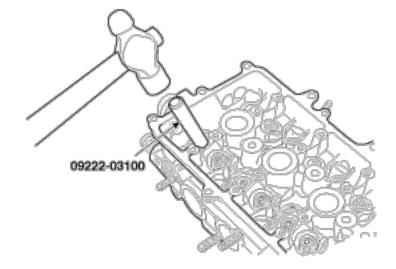
#### REASSEMBLY

#### NOTICE

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- 1. Install the valves.
  - (1) Using the SST (09222-03100), push in a new valve stem seal.

#### NOTICE

- Do not reuse old valve stem seals.
- Incorrect installation of the seal could result in oil leakage past the valve guides.

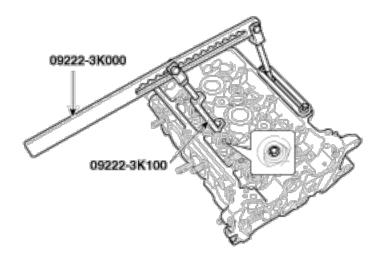


(2) Install the valve, valve spring and spring retainer.

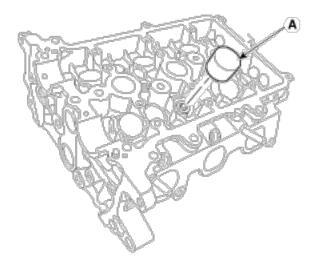
#### NOTICE

Place valve springs so that the cone shape side is upward retainer side.

(3) Using the SST (09222-3K000, 09222-3K100), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.



- (4) Lightly tap the end of each valve stem two or three times with the wooden handle of a hammer to ensure proper seating of the valve and retainer lock.
- 2. Install the mechanical lash adjuster (A).



#### NOTICE

MLA can be reinstalled in its original position.

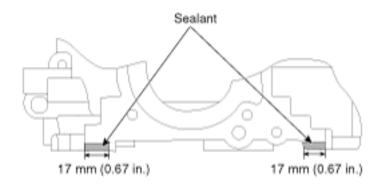
However, the valve lash clearances must be rechecked and adjusted accordingly before the cylinder head is installed onto the cylinder block.

Refer to General information in EM section for Valve Clearance checking and adjustment procedure.

#### **INSTALLATION**

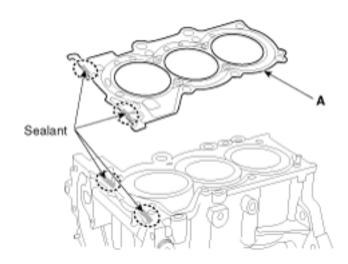
#### NOTICE

- · Thoroughly clean all parts to be assembled.
- · Always use a new head and manifold gasket.
- The cylinder head gasket is a metal gasket. Take care not to bend it.
- Rotate the crankshaft, set the No.1 piston at TDC.
- 1. Install the cylinder head gasket.
  - (1) The sealant locations on cylinder head gasket, cylinder block and timing chain lower case must be free of engine oil and etc.
  - (2) Apply sealant TB1217 or LT5900 on the cylinder block top surface (Refer to below illustration) before assembling the cylinder head gasket.



<Before installing head gasket>

(3) Install the cylinder head gasket (A) on the cylinder block.

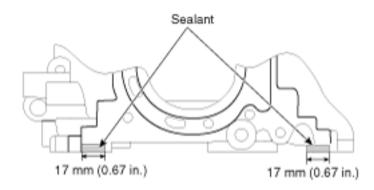


#### NOTICE

Be careful of the installation direction.

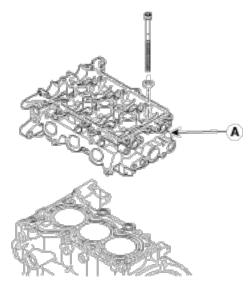
(4) Apply sealant TB1217 or LT5900 on the cylinder head gasket top surface (Refer to below illustration) after assembling the cylinder head gasket.

Bead width: 2.0 ~ 3.0 mm (0.0787 ~ 0.1181 in)



#### <After installing head gasket>

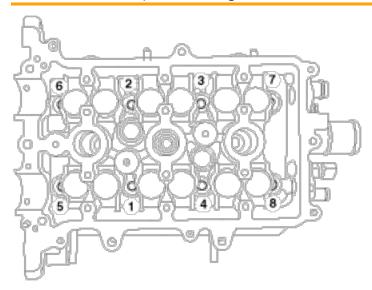
- (5) Remove the extruded sealant after assembling the cylinder head assembly.
- 2. Install the cylinder head assembly.
  - (1) Place the cylinder head assembly (A) quietly in order not to damage the gasket with the bottom part of the end.



(2) Using SST (09221-4A000), tighten the cylinder head bolts and plate washers, in several passes, in the sequence shown.

#### **Tightening torque:**

 $12.7 \sim 16.7 \text{ N.m} (1.3 \sim 1.7 \text{ kgf.m}, 9.4 \sim 12.3 \text{ lb-ft}) + 90^{\circ} \sim 95^{\circ} + 120^{\circ} \sim 125^{\circ}$ 



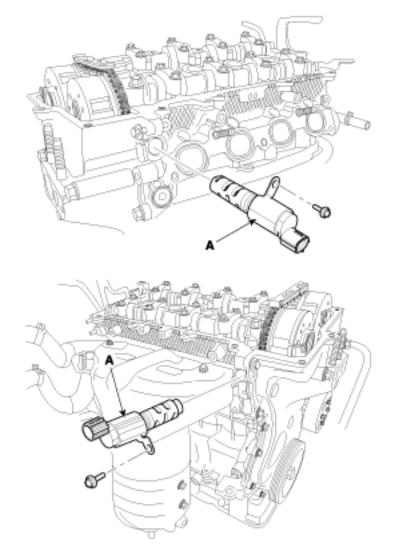
#### NOTICE

Do not reuse the cylinder head bolts.

3. Install the intake / exhaust OCV (Oil control valve) (A).

#### Tightening torque:

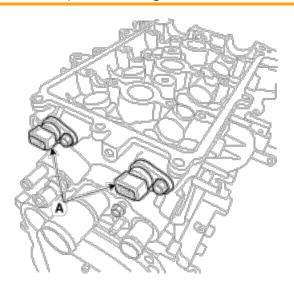
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



4. Install the Intake CMPS (Camshaft Position Sensor) (A), air cleaner mounting bracket (B).

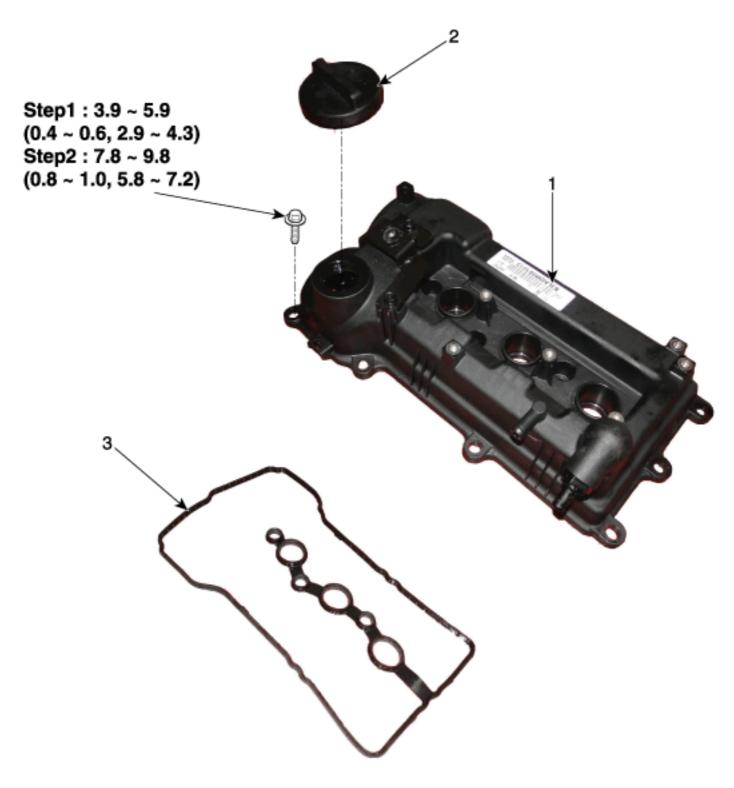
### Tightening torque:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



5. Install the other parts in the reverse order of removal.

### **COMPONENTS**



Torque : N.m(kgf.m, lb-ft)

- 1. Cylinder head cover
- 2. Engine oil cap

- 3. Cylider head cover gasket
- 4. Camshaft position sensor

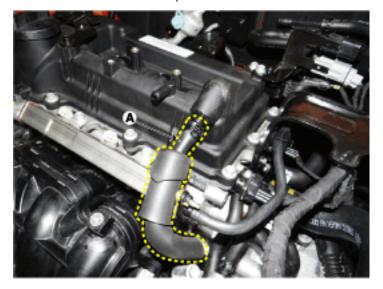
#### **REMOVAL**

### **▲** CAUTION

- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

#### NOTICE

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No.1 piston is at top dead center.
- 1. Disconnect the battery negative terminal.
- Remove the air cleaner assembly. (Refer to Intake and Exhaust System - "Air Cleaner")
- 3. Remove the ignition coils. (Refer to Engine Electrical System "Ignition Coil")
- 4. Disconnect the PCV (Positive crankcase ventilation) hose (A).



5. Remove the cylinder head cover (A).



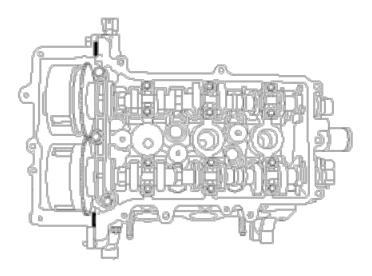
- 1. Install the cylinder head cover.
  - (1) Install new cylinder head cover gasket on the cylinder head cover.

# **▲** CAUTION

Do not reuse the cylinder head cover gasket.

- (2) The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
- (3) After applying sealant (MS721-40AA), it should be assembled within 5minutes.

**Bead width :**  $2.0 \sim 3.0 \text{ mm} (0.08 \sim 0.12 \text{ in.})$ 



(4) Install the cylinder head cover bolts as following method with two steps.

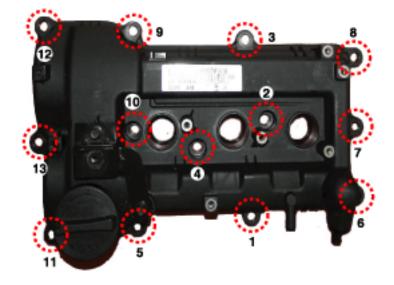
#### **Tightening torque**

Step 1:

 $3.9 \sim 5.9 \text{ N.m}$  (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

Step 2:

 $7.8 \sim 9.8 \text{ N.m} (0.8 \sim 1.0 \text{ kgf.m}, 5.8 \sim 7.2 \text{ lb-ft})$ 



2. Install the other parts in the reverse order of removal.

# Engine Mechanical System > Engine and Transaxle Assembly > Engine and Transaxle Assembly > Repair procedures

### **REMOVAL**

### **▲** CAUTION

- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

#### NOTICE

- Mark all wiring and hoses to avoid misconnection.
- For release the fuel system pressure before remove the engine assembly, start the engine without fuel pump relay, and then turn off the ignition switch after engine stops.
- 1. Disconnect the battery negative terminal.
- Remove the air duct and air cleaner assembly. (Refer to Intake and Exhaust System - "Air Cleaner")
- Disconnect the mounting bracket and then remove the battery. (Refer to Engine Electrical System - "Battery")
- Disconnect the ECM connector and then remove the ECM. (Refer to Fuel System - "Engine Control Module")
- Remove the battery tray.(Refer to Engine Electrical System "Battery")
- 6. Remove the Engine room under cover.
- 7. Loosen the drain plug and drain the coolant. Open the radiator cap to make rapid draining. (Refer to Cooling System "Coolant")
- 8. Recover the refrigerant and remove the high & low pressure pipe. (Refer to Heating and Ventilation, Air Conditioning System "Compressor")
- 9. Disconnect the radiator upper hose, the reservoir hose and the lower hose. (Refer to Cooling System "Radiator Hose")
- Disconnect the AT cooler hose.
   (Refer to Automatic Transaxle System "Automatic Transaxle")
- 11. Disconnect the wiring connectors and harness clamps, and remove the wiring and protectors from the cylinder head and intake manifold.
  - (1) The exhaust OCV (Oil Control Valve) connector (A)
  - (2) The CKPS (Crankshaft Position Sensor) connector (B)
  - (3) The condenser connector (C)
  - (4) The ground line (D)



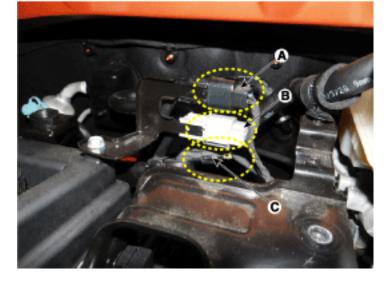
- (5) The intake OCV(Oil Control Valve) connector (A)
- (6) The knock sensor connector (B)
- (7) The alternator connector (C)



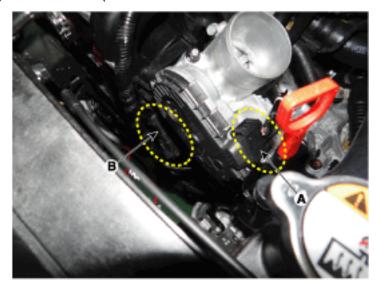
- (8) The ignition coil connectors (A)
- (9) The injector connectors (B)
- (10) The wiring protector (C)



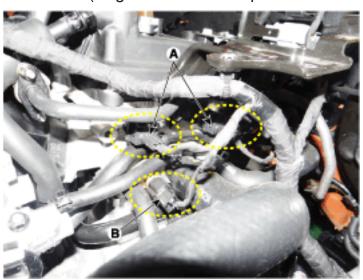
- (11) The front oxygen sensor connector (A)
- (12) The rear oxygen sensor connector (B)
- (13) The PCSV (Purge Control Solenoid Valve) connector (C)



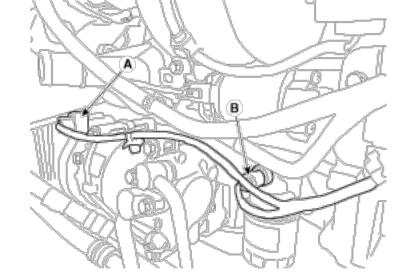
- (14) The ETC (Electronic Throttle Control) connector (A)
- (15) The MAPS (Manifold Absolute Pressure Sensor) connector (B)



- (16) The intake CMPS (Camshaft Position Sensor) connector (A)
- (17) The ECTS (Engine Coolant Temperature Sensor) connector (B)



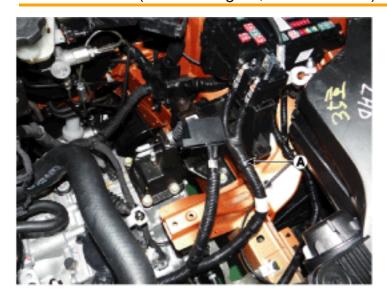
- (18) The compressor switch connector (A)
- (19) The OPS (Oil Pressure Switch) connector (B)



12. Disconnect the (+) cable (A) from the fuse/relay box.

#### **Tightening torque:**

 $6.9 \sim 10.8 \text{ N.m} (0.7 \sim 1.1 \text{ kgf.m}, 5.1 \sim 8.0 \text{ lb-ft})$ 



13. Disconnect the gasoline fuel hoses (A).



- 14. Remove the transaxle wire harness connectors and control cable from the transaxle.
- 15. Remove the steering column universal joint bolt. (Refer to Steerint System - "Steering Column")
- Remove the roll rod bracket.
   (Refer to Engine and Transmission Assembly "Engine Mounting")
- 17. Remove the front muffler.
  (Refer to Intake and Exhaust System "Muffler")
- Remove the sub frame assembly.
   (Refer to Suspension System "Sub Frame")

- After removing the engine and transaxle mounting bolts and nuts, the engine and transaxle assembly may be fallen downward. Support them securely with floor jack.
- Verify that the hoses and connectors are disconnected before removing the engine and transaxle assembly.
- 19. Disconnect the ground cable, and then remove the engine support mounting bracket. (Engine and Transaxle Assembly "Engine Mounting")
- 20. Remove the transaxle mounting bracket through bolt (A).

#### **Tightening torque:**

88.3 ~ 107.9 N.m (9.0 ~ 11.0 kgf.m, 65.1 ~ 79.6 lb-ft)



21. Remove the engine and transaxle assembly by lifting vehicle.



### **▲** CAUTION

When remove the engine and transaxle assembly, be careful not to damage any surrounding parts or body components.

#### **INSTALLATION**

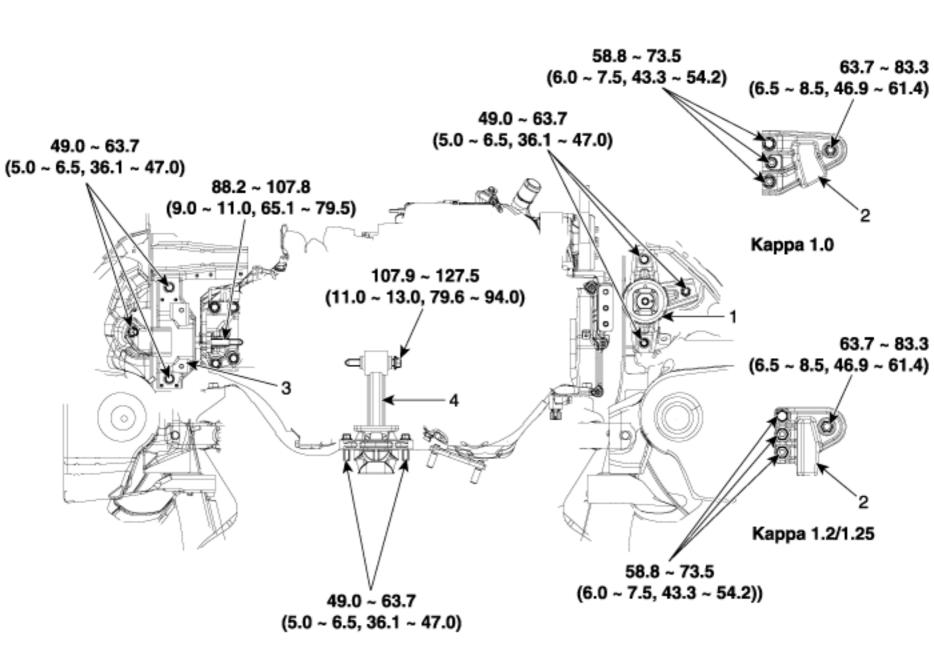
Installation is in the reverse order of removal.

Perform the following:

- · Adjust a shift cable.
- Refill engine with engine oil.
- · Refill a transaxle with fluid.

- Refill power steering fluid.
- Refill a radiator and a reservoir tank with engine coolant.
- Clean battery posts and cable terminals and assemble.
- Inspect for fuel leakage.
- After assemble the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.
- Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line.
- Bleed air from the cooling system.
  - Start engine and let it run until it warms up. (until the radiator fan operates 3 or 4 times.)
  - Turn off the engine. Check the level in the radiator, add coolant if needed. This will allow trapped air to be removed from the cooling system.
  - Put radiator cap on tightly, then run the engine again and check for leaks.

#### **COMPONENTS**



# Torque : N.m (kgf.m, lb-ft)

1.	Engine	mounting	bracket
----	--------	----------	---------

2. Engine mounting support bracket

- 3. Transaxle mounting bracket
- 4. Roll rod bracket

#### **REMOVAL AND INSTALLATION**

### [Egnine mounting support bracket]

1. Install the jack to the edge of upper oil pan to support the engine.

#### NOTICE

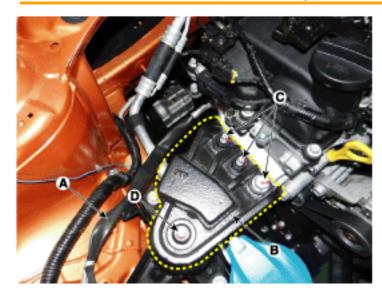
Put the rubber block between the jack and oil pan to avoid damaging the oil pan.

2. Disconnect the ground (A), and then remove the engine mounting support bracket (B).

#### Tightening torque:

Bolt and Nuts (C): 58.8 ~ 73.5 N.m (6.0 ~ 7.5 kgf.m, 43.3 ~ 54.2 lb-ft)

Nut (D): 637 ~ 83.3 N.m (6.5 ~ 8.5 kgf.m, 46.9 ~ 61.4 lb-ft)



3. Remove the engine mounting bracket (A).

#### **Tightening torque:**

49.0 ~ 63.7 N.m (5.0 ~ 6.5 kgf.m, 36.1 ~ 47.0 lb-ft)



4. Installation is reverse order of removal.

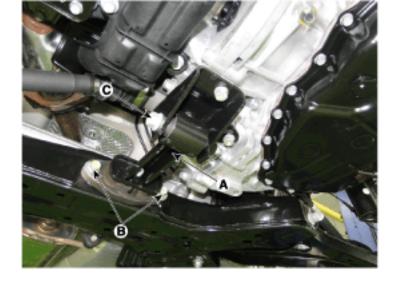
# [Roll road Mounting]

1. Remove the roll rod bracket (A).

#### **Tightening torque:**

B:  $49.0 \sim 63.7 \text{ N.m}$  (5.0  $\sim 6.5 \text{ kgf.m}$ ,  $28.9 \sim 47.0 \text{ lb-ft}$ )

C: 107.9 ~ 127.5 N.m (11.0 ~ 13.0 kgf.m, 79.6 ~ 94.0 lb-ft)



2. Remove the roll rod mounting suppot bracket (A).

Tightening torque :

49.0 ~ 68.6 N.m (5.0 ~ 7.0 kgf.m, 36.2 ~ 50.6 lb-ft)



3. Installation is reverse order of removal.



Torque : N.m(kgf.m, lb-ft)

1. Under cover 2. Side cover

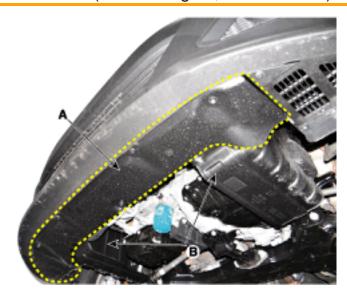
Engine Mechanical System > Engine and Transaxle Assembly > Engine Room Under Cover > Repair procedures

# **REMOVAL AND INSTALLATION**

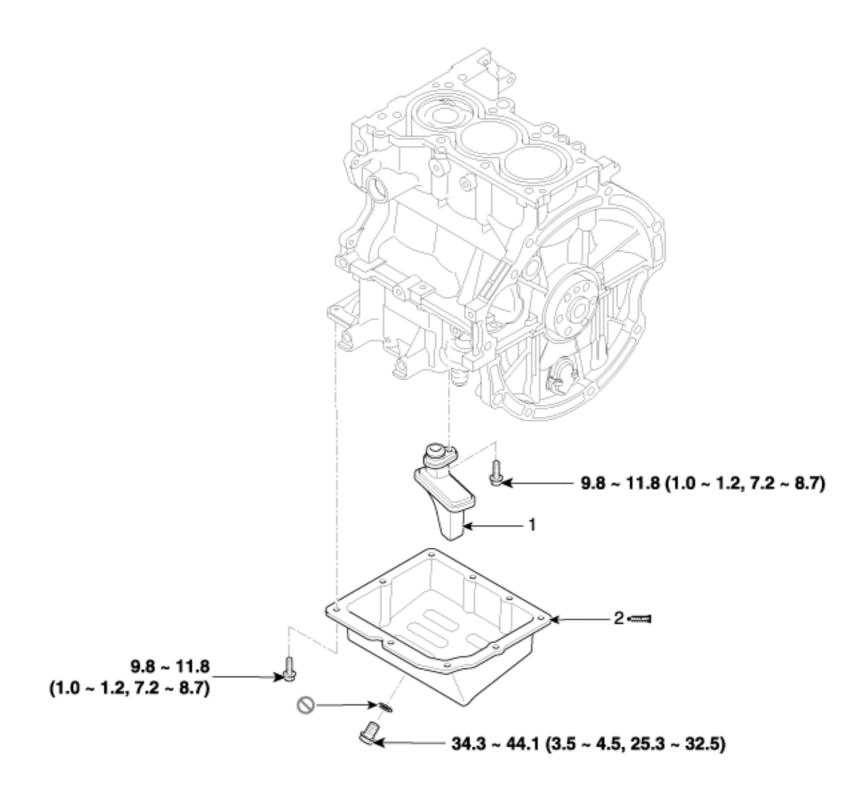
1. Remove the engine room under cover (A) and side cover (B).

# Tightening torque:

 $3.9 \sim 5.9 \text{ N.m} (0.4 \sim 0.6 \text{ kgf.m}, 2.9 \sim 4.3 \text{ lb-ft})$ 



2. Installation is reverse order of removal.



Torque : N.m(kgf.m, lb-ft)

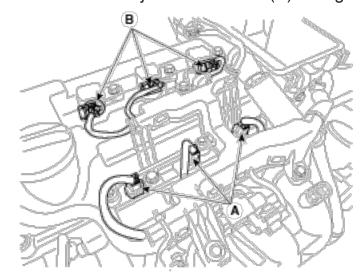
1. Oil screen 2. Oil pan

#### **COMPRESSION PRESSURE INSPECTION**

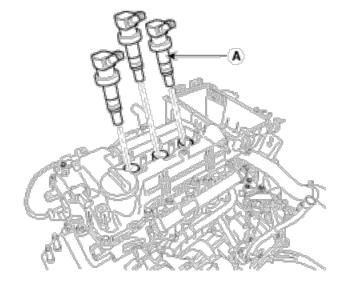
# NOTICE

If there is lack of power, excessive oil consumption or poor fuel economy, measure te compression pressure.

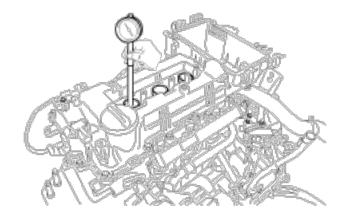
- 1. Start the engine and allow to warm up to operating temperature (about five minutes). Stop the engine.
- 2. Remove the engine cover.
- 3. Disconnect the injector connector (A) and ignition coil connector (B).



4. Remove the ignition coils (A).



- 5. Remove the three spark plugs using a 16mm spark plug wrench.
- 6. Check the cylinder compression pressure.
  - (1) Insert a compression gauge into the spark plug hole.



- (2) Fully open throttle.
- (3) While cranking the engine, measure the compression pressure.

### NOTICE

Always use a fully charged battery to obtain engine speed of 200rpm or more.

(4) Repeat step (1) through (3) for each cylinder.

### NOTICE

This measurement must be done in as short atime as possible

#### **Compression pressure:**

1,373 kPa (14.0 kg/cm², 199.0 psi)

#### Minimum pressure:

1,226 kPa (12.5 kg/cm<sup>2</sup>,178.0 psi)

#### Difference between each cylinder:

98 kPa (1.0 kg/cm<sup>2</sup>, 14 psi) or less

- (5) If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat step (1) through (3) for cylinders with low compression.
  - If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
  - If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.
- 7. Reinstall the spark plugs.

#### **Tightening torque:**

14.7 ~ 24.5 N.m (1.5 ~ 2.5 kgf.m, 10.8 ~ 18.1 lb-ft)

8. Install the ignition coil.

#### **Tightening torque:**

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

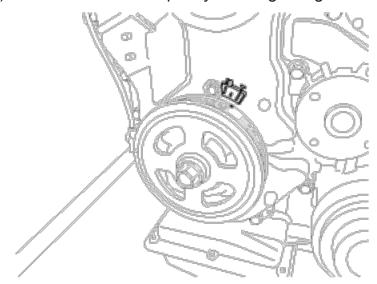
- 9. Connect the injector connectors and ignition coil connectors.
- 10. Some DTC's may exist after the inspection test and may need to be manually cleard with GDS.

### Valve Clearance Inspection and Adjustment

### NOTICE

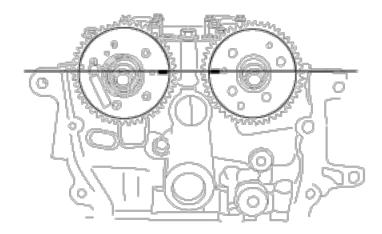
Inspect and adjust the valve clearance when the engine is cold (Engine coolant temperature : 20°C (68°F)) and cylinder head is installed on the cylinder block.

- Remove the cylinder head cover. (Refer to Timing System)
- 2. Set No.1 cylinder to TDC/compression.
  - (1) Turn the crankshaft pulley and align its groove with the timing mark "T" of the timing chain cover.

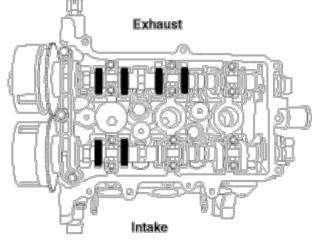


(2) Check that the TDC marks of the CVVT sprockets are in straight line on the cylinder head surface as shown in the illustration.

If not, turn the crankshaft one revolution (360°)



- 3. Inspect the valve clearance.
  - (1) Check only the valve indicated as shown (Intake 1st and Exhaust 1st, 2nd). Measure the valve clearance.



[No.1 cylinder: TDC/Compression]

- Using a thickness gauge, measure the clearance between the tappet and the base circle of camshaft.
- Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting tappet.

#### Valve clearance

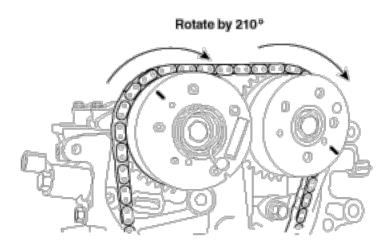
Specification

Engine coolant temperature : 20°C [68°F]

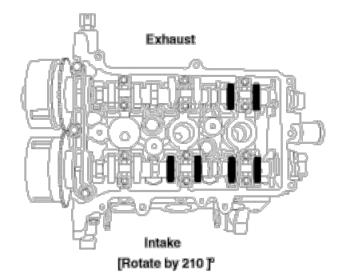
Limit

Intake :  $0.17 \sim 0.23$  mm ( $0.0067 \sim 0.0091$  in.) Exhaust :  $0.22 \sim 0.28$  mm ( $0.0087 \sim 0.0110$  in.)

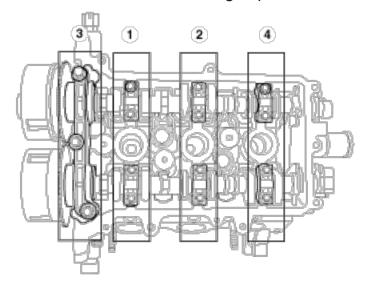
(2) Rotate the intake and exhaust camshafts by 210° in clockwise direction.



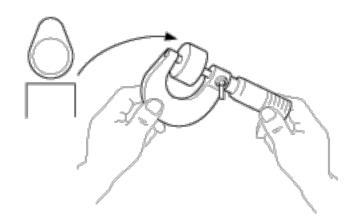
(3) Check only valves indicated as shown. (Intake 2nd, 3rd and Exhaust 3rd) Measure the valve clearance.



- 4. Adjust the intake and exhaust valve clearance.
  - (1) Set the No.1 cylinder to the TDC/compression.
  - (2) Remove the timing chain. (Refer to Timing System)
  - (3) Remove the camshaft bearing caps with the order below.



(4) Measure the thickness of the removed tappet using a micrometer.



(5) Calculate the thickness of a new tappet so that the valve clearance comes within the specified value.

Valve clearance [Engine coolant temperature : 20°C (68°F)]

T: Thickness of removed tappet A: Measured valve clearance N: Thickness of new tappet

Intake : N = T + [A - 0.20 mm (0.0079 in.)]Exhaust : N = T + [A - 0.25 mm (0.0098 in.)]

(6) Select a new tappet with a thickness as close as possible to the calculated value.

### NOTICE

Shims are available in 41 size increments of 0.015mm (0.0006in.) from 2.850mm (0.112in.) to 3.450mm (0.135in.)

- (7) After applying engine oil on the selected tappet at the periphery and top surface, insert tappet into cylinder head gently.
- (8) Install the intake and exhaust camshafts.
- (9) Install the camshaft bearing caps with the order below.

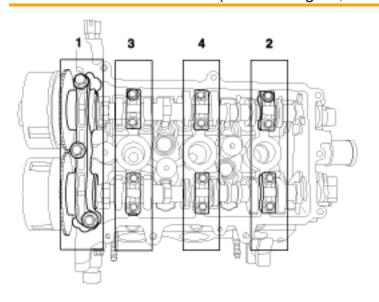
#### **Tightening torque**

Step 1

M6 bolts: 5.9 N.m (0.6 kgf.m, 4.3 lb-ft) M8 bolts: 9.8 N.m (1.0 kgf.m, 7.2 lb-ft)

Step 2

M6 bolts :  $11.8 \sim 12.7$  N.m ( $1.2 \sim 1.3$  kgf.m,  $8.7 \sim 9.4$  lb-ft) M8 bolts :  $18.6 \sim 22.6$  N.m ( $1.9 \sim 2.3$  kgf.m,  $13.7 \sim 16.6$  lb-ft)



(10) Turn the crankshaft two turns in the operating direction(clockwise), and then check that the TDC marks of the CVVT sprockets are in straight line on the cylinder head surface.

(11) Recheck the valve clearance.

# Valve clearance [Engine coolant temperature : 20°C (68°F)]

[Specification]

Intake: 0.17 ~ 0.23 mm (0.0067 ~ 0.0090 in.) Exhaust: 0.22 ~ 0.28 mm (0.0087 ~ 0.0110 in.)

Inatall the timing chain. (Refer to Timing System)

# SPECIAL SERVICE TOOLS

OF EGIAL SERVICE TOOLS				
Tool (Number and name)	Illustration	Use		
Crankshaft pulley adapter (09231-03100) Crankshaft pulley adapter holder (09231-2J210)	A B B	Removal and installation of the crankshaft pulley A: 09231-03100 B: 09231-2J210 (holder)		
Torque angle adapter (09221-4A000)	To all the second	Installation of bolts & nuts needing an angular method		
Valve stem seal installer (09222-03100)		Installation of the valve stem seal		
Valve spring compressor & holder (09222-3K000) (09222-3K100)	A	Removal and installation of the intake or exhaust valves A: 09222-3K000 B: 09222-3K100 (holder)		
Crankshaft rear oil seal installer (09214-03100) (09231-H1100)	09231-H1100 09214-03100	Installation of the crankshaft rear oil seal		
Oil pan remover (09215-3C000)		Removal of oil pan		
Oil filter wrench (09263-02000)		Removal and installation of oil filter		

Crankshaft oil seal installer (09214-1R000) (09231-H100)	Installation of the crankshaft front oil seal

Intake

Exhaust

Intake

Exhaust

**Description** 

# **SPECIFICATIONS**

Number of cylinders

Stem outer diameter

Thickness of valve

Face angle

head

(margin)

General

Type

Bore		71.0 mm (2.7952 in)	
Stroke		84.0 mm (3.3070 in)	
Total displacement		998 cc (60.9 cu.in)	
Compression ratio		10.5 : 1	
Firing order		1-2-3	
Valve timing		·	
InIntake valve	Opens	ATDC 10°	
iiiiiiake vaive	Closes	ABDC 58.7°	
Exhaust valve	Opens	BBDC 42.3°	
Exilaust valve	Closes	ATDC 5°	
Cylinder head			
Flatness of gasket surface		Less than 0.05 mm (0.0020 in) Less than 0.02 mm (0.0008 in) / 100 x 100	
Flatness of manifold	Intake	Less than 0.1 mm (0.0039 in)	
mounting surface	Exhaust	Less than 0.1 mm (0.0039 in)	
Camshaft		·	
Comboight	Intake	40.79833 mm (1.6062 in)	
Camheight	Exhaust	40.39819 mm (1.5905 in)	
Intake/Exhaust No.1  Journal outer Diameter  Intake/Exhaust No.2~5		36.464 ~ 36.478 mm (1.4355 ~ 1.4361 in)	
		20.964 ~ 20.978 mm (0.8254 ~ 0.8259 in)	
Valve			
Valva langth	Intake	92.85 mm (3.6555 in)	
Valve length	Exhaust	93.37 mm (3.6759 in)	

**Specification** 

In-line, DOHC

3

5.465 ~ 5.480 mm (0.2151 ~

0.2157 in)

5.448 ~ 5.460 mm (0.2144 ~

0.2149 in)

1.50 mm (0.0590 in)

1.75 mm (0.0688 in)

Limit

Valve stem to valve	Intake	0.020 ~ 0.047 mm (0.00078 ~ 0.00185 in)	
guide clearance	Exhaust	0.040 ~ 0.064 mm (0.00157 ~ 0.00251 in)	
Valve spring			
Free length		47.9 mm (1.8858 in)	
Load		15.29 ± 0.82 kgf / 34.2 mm (150 ± 8.1N / 1.3465 in) 26.51 ± 0.95 kgf / 25.7 mm (260 ± 9.4N / 1.0118 in)	
Out of squareness		1.5° MAX	
Cylinder block			
Cylinder bore		71.00~71.03 mm (2.7952 ~2.7964 in)	
Flatness of gasket surfa	ce	Less than 0.05 mm (0.0020 in) Less than 0.02 mm (0.0008 in) / 100 x 100	
Piston			
Piston outer diameter		70.97~71.00 mm (2.7940 ~ 2.7952 in)	
Piston to cylinder cleara	nce	0.02 ~ 0.04 mm (0.0008 ~ 0.0016 in)	
	No. 1 ring groove	1.03 ~ 1.05 mm (0.0405 ~ 0.0413 in)	
Ring groove width	No. 2 ring groove	1.23 ~ 1.25 mm (0.0484 ~ 0.0492 in)	
	Oil ring groove	2.010 ~ 2.025 mm (0.0791 ~ 0.0797 in)	
Piston ring			
	No. 1 ring	0.04 ~ 0.08 mm (0.0015 ~ 0.0031 in)	
Side clearance	No. 2 ring	0.04 ~ 0.08 mm (0.0015 ~ 0.0031 in)	
	Oil ring	0.040 ~ 0.115 mm (0.0015 ~ 0.0045 in)	
	No. 1 ring	0.13 ~ 0.25 mm (0.0051 ~ 0.0048 in)	
End gap	No. 2 ring	0.30 ~ 0.45 mm (0.0118 ~ 0.0177 in)	
	Oil ring	0.1 ~ 0.4 mm (0.0039 ~ 0.0157 in)	
Piston pin			
Piston pin outer diameter		18.000 ~ 18.003 mm (0.7086 ~ 0.7087 in)	
Piston pin hole inner diameter		18.013 ~ 18.017 mm (0.7092 ~ 0.7093 in)	

Piston pin hole clearance		0.010 ~ 0.017 mm (0.00039 ~ 0.00067 in)	
Connecting rod small end hole inner diameter		17.974 ~ 17.985 mm (0.7076 ~ 0.7474 in)	
Connecting rod small er	nd hole clearance	-0.015 ~ -0.029 mm (0.00059 ~ 0.00114 in)	
Piston pin press-in load		250 ~ 1050 kg (551 ~ 2315 lb)	
Connecting rod			
Connecting rod big end	inner diameter	42.000 ~ 42.018 mm (1.6535~1.6542 in)	
Connecting rod bearing	oil clearance	0.018 ~ 0.036 mm (0.0007 ~ 0.0014 in)	
Side clearance		0.1 ~ 0.25 mm (0.0039 ~ 0.0098 in)	
Crankshaft			
Main journal outer diam	eter	47.942 ~ 47.960 mm (1.8874 ~ 1.888 in)	
Pin journal outer diamet	er	38.954 ~ 38.972 mm (1.5336 ~ 1.5343 in)	
Main bearing oil clearance		0.006 ~ 0.024 mm (0.0002 ~ 0.0009 in)	
End play		0.05 ~ 0.25 mm (0.0020 ~ 0.0098 in)	
Oil pump			
Side clearance	Inner rotor	0.040 ~ 0.090 m (0.0016 ~ 0.0035 in)	
Side clearance	Outer rotor	0.040 ~ 0.090 m (0.0016 ~ 0.0035 in)	
Poliof opring	Free length	-	
Relief spring	Load	3.9 ± 0.5 bar	
Engine oil			
	Total	3.3 L (3.48 US qt, 2.90 Imp qt)	When replacing a short engine or a block assembly
	Oil pan	2.7 L (2.85 US qt, 2.37 Imp qt)	
Oil quantity  Drain and refill		Except India : 2.9 L (3.06 US qt, 2.55 Imp qt) For India :	Including oil filter
		3.0 L (3.17 US qt, 2.64 Imp qt)	
	December	For all except Middle East and India ILSAC GF-4, API SM or above / 5W-20 ACEA A5, API SM or above /	
	Recommendation	5W-30	

		For Middle East and I ACEA A5, API SM or a 5W-30			
Oil grade	Allowed	API SL, SM or above ILSAC GF-3, GF4 or a ACEA A3, A5 or above For information on Structures with the "Lubrication System of the "Lubrication System of the structure of the stru	above oove SAE ed on s, refer		f the recommended oil is not available
		SK (ZIC LD 5W-30), Ch (KIXX G1 LL), Tota (QUARTZ HKS G-3 QUARTZ INEO MC3 5V Shell (HELIX ULTRA 5W-30, HELIX ULTRA 40), Fuchs (TITAN SUPERSYN LONG L 5W-30/40)	tal 310, 5W-30), AH-E A 5W-	-	gine oil approved by HYUNDAI
Oil pressure (at 1000rpn	m)	1.3 bar or above	•		rature in oil pan : 110 C (230 ± 3.6°F)
Cooling method					
Cooling system		Forced circulation with pump	ı water		
Coolant quantity		MT : Approx. 4.9 L (1 U.S.gal., 5.17 U.S.qt., Imp.qt.) AT : Approx. 4.8 L (1 U.S.gal., 5.07 U.S.qt., Imp.qt.)	1.26		
	Туре	Wax pellet type			
Thermostat .	Opening temperature	88 ± 1.5°C (190.4 ± 2			
	Full opening temperature	100°C (212°F)			
Radiator cap	Main valve opening pressure	93.16 ~ 122.58 kp (0.95 ~ 1.2 5kg/cm², 13 17.78 psi)			
Radiatoi Cap	Vacuum valve opening pressure	0.98 ~ 4.90 kPa (0.01 ~ 0.05 kg/cm², 0.14 ~ 0.71 psi)			
Water temperature sen	nsor				
Туре		Thermistor type	;		
Resistance 20°C (68°F)		2.45 ± 0.14 kΩ			
Resistance	80°C (176°F)	0.3222 kΩ			
Tightening Torques	s				
	Item	N.m	kgf.	m	lb-ft
Cylinder block					
<u> </u>					

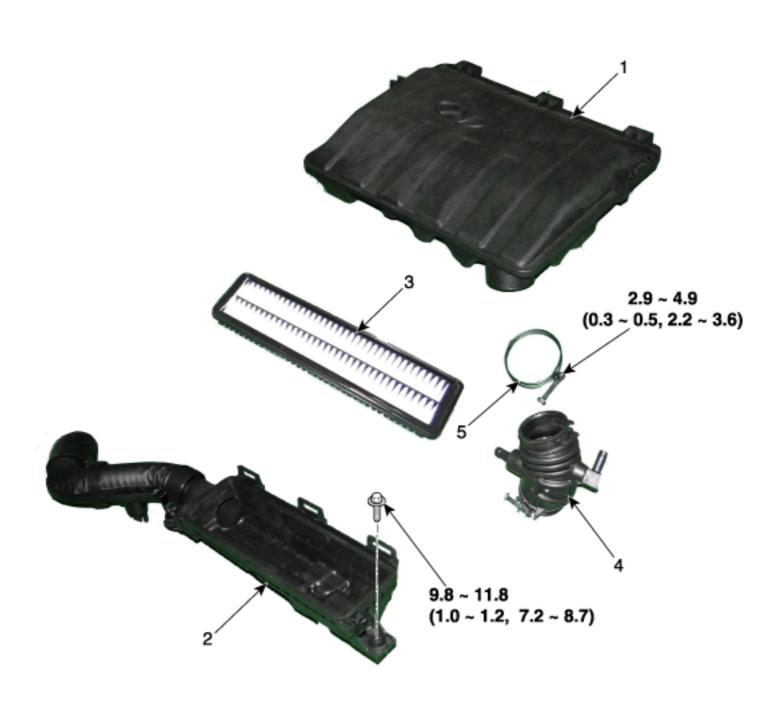
Ladder frame bolt	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
Engine mounting			
Engine mounting bracket and body fixing blot	49.0 ~ 63.7	5.0 ~ 6.5	36.1 ~ 47.0
Engine mounting bracket and body fixing nut	49.0 ~ 63.7	5.0 ~ 6.5	36.1 ~ 47.0
Engine mounting insulator to engine mounting support bracket fixing nut	63.7 ~ 83.3	6.5 ~ 8.5	46.9 ~ 61.4
Engine mounting support bracket and engine support bracket fixing bolt	58.8 ~ 73.5	6.0 ~ 7.5	43.3 ~ 54.2
Engine mounting support bracket and engine support bracket fixing nut	58.8 ~ 73.5	6.0 ~ 7.5	43.3 ~ 54.2
Transaxle mounting bracket and body fixing bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.1 ~ 47.0
Transaxle mounting bracket and body fixing nut	49.0 ~ 63.7	5.0 ~ 6.5	36.1 ~ 47.0
Transaxle mounting support bracket to transaxle mounting fixing bolt	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Roll rod bracket and sub frame fixing bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.1 ~ 47.0
Roll rod bracket and roll rod mounting support bracket bolt	107.9 ~ 12.75	11.0 ~ 13.0	79.6 ~ 94.0
Main moving system			
Connecting rod bearing cap bolt	[10.8 ~ 14.7] + [88 ~ 92°]	[1.1 ~ 1.5] + [88 ~ 92°]	[8.0 ~ 10.8] + [88 ~ 92°]
Crankshaft main bearing cap bolt	[17.7 ~ 21.6] + [88 ~ 92°]	[1.8 ~ 2.2] + [88 ~ 92°]	[13.0 ~ 15.9] + [88 ~ 92°]
Fly wheel bolt (M/T)	68.6 ~ 78.5	7.0 ~ 8.0	50.6 ~ 57.9
Drive plate bolt (A/T)	68.6 ~ 78.5	7.0 ~ 8.0	50.6 ~ 57.9
Timing chain			
Timing chain cover bolt (A)	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Timing chain cover bolt (B)	44.1 ~ 53.9	4.5 ~ 5.5	32.5 ~ 39.8
Timing chain cover bolt (C)	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Crankshaft pulley bolt	[55.9 ~ 61.8] + [38 ~ 42°]	[5.7 ~ 6.3] + [38 ~ 42°]	[41.2 ~ 45.5] + [38 ~ 42°]
CVVT bolt	63.7 ~ 73.5	6.5 ~ 7.5	47.0 ~ 54.2
Timing chain tensioner bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain tensioner arm bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain guide bolt	18.6 ~ 21.6	1.9 ~ 2.2	13.7 ~ 15.9
Cylinder head			
Cylinder head cover bolt	[3.9 ~ 5.9] → [7.8 ~ 9.8]	[0.4 ~ 0.6] → [0.8 ~ 1.0]	[2.9 ~ 4.3] → [5.8 ~ 7.2]
Camshaft bearing cap bolt (M6)	[5.9] → [11.8 ~ 12.7]	[0.6] → [1.2 ~ 1.3]	[4.3] → [8.7 ~ 9.4]
Camshaft front bearing cap bolt (M8)	[9.8] → [18.6 ~ 22.6]	[1.0] → [1.9 ~ 2.3]	[7.2] → [13.7 ~ 16.6]
Cylinder head bolt	[12.7 ~ 16.7] + [90 ~ 95°] + [120 ~ 125°]	[1.3 ~ 1.7] + [90 ~ 95°] + [120 ~ 125°]	[9.4 ~ 12.3] + [90 ~ 95°] + [120 ~ 125°]
OCV bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cooling system			

Water pump pulley bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump bolt	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Heater pipe bolt & nut	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Thermostat housing bolt & nut	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Water inlet fitting bolt & nut	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Lubrication system			
Oil filter	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6
Oil pump cover screw	5.9 ~ 8.8	0.6 ~ 0.9	4.3 ~ 6.5
Oil level gauge guide bolt	8.8 ~ 13.7	0.9 ~ 1.4	6.5 ~ 10.1
Oil pan bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan drain plug	34.3 ~ 44.1	3.5 ~ 4.5	25.2 ~ 32.4
Oil screen bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pressure switch	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Intake and exhaust system			
Intake manifold bolt & nut	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Exhaust manifold stay	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.1
Exhaust manifold heat protector	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Throttle body fixing self screw	6.4 ~ 8.3	0.65 ~ 0.85	4.7 ~ 6.1
Exhaust manifold nut	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Front mufler nut	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Center muffler pipe and main muffler clamp nut	17.7 ~ 27.5	1.8 ~ 2.8	13.0 ~ 20.3

TROUBLESHOOTING				
Symptom	Suspect area	Remedy		
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings. Loose or damaged engine drive plate.	Replace the crankshaft and bearings as required. Repair or replace the drive plate as required.		
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression.Repair or replace as required.		
	Worn crankshaft thrust bearings	Replace the crankshaft and bearings as required.		
Engine misfire with abnormal valve train noise.	Stuck valves. (Carbon buildup on the valve stem)	Repair or replace as required.		
	Excessive worn or mis-aligned timing chain.	Replace the timing chain and sprocket as required.		
	Worn camshaft lobes.	Replace the camshaft and valve lifters.		
	HLA sponge	Run the engine at 2500~3000rpm within 15 minutes. If it dosen't disappear, refer to cylinder head assembly in this group.		
Engine misfire with coolant consumption.	<ul> <li>Faulty cylinder head gasket and/or cranking or other damage to the cylinder head and engine block cooling system.</li> </ul>	Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket.		
	<ul> <li>Coolant consumption may or may not cause the engine to overheat.</li> </ul>	Repair or replace as required.		
Engine misfire with excessive oil consumption.	Worn valves, guides and/or valve stem oil seals.	Repair or replace as required.		
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	<ul> <li>Inspect the cylinder for a loss of compression.</li> <li>Repair or replace as required.</li> </ul>		
Engine noise on start-up, but only lasting a few seconds.	Incorrect oil viscosity.	Drain the oil.     Install the correct viscosity oil.		
	Worn crankshaft thrust bearing.	Inspect the thrust bearing and crankshaft.		
		Repair or replace as required.		
Upper engine noise, regardless of	Low oil pressure.	Repair or replace as required.		
engine speed.	Broken valve spring.	Replace the valve spring.		
	Worn or dirty valve lifters.	Replace the valve lifters.		
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.		

	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.	
	Worn camshaft lobes.	Inspect the camshaft lobes.	
		Replace the timing camshaft and valve lifters as required.	
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.	
	Stuck valves.Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the valves and valve guides, then repair as required.	
	Worn drive belt, idler, tensioner and bearing.	Replace as required.	
Lower engine noise, regardless of	Low oil pressure.	Repair as required.	
engine speed.	Loose or damaged drive plate.	Repair or replace the drive plate.	
	Damaged oil pan, contacting the oil	Inspect the oil pan.	
	pump screen.	Inspect the oil pump screen.	
		Repair or replace as required.	
	Oil pump screen loose, damaged or	Inspect the oil pump screen.	
	restricted.	Repair or replace as required.	
	Excessive piston-to-cylinder bore clearance.	Inspect the piston, piston pin and cylinder bore.	
		Repair as required.	
	Excessive piston pin-to-piston clearance.	Inspect the piston, piston pin and the connecting rod.	
		Repair or replace as required.	
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required.	
		The connecting rod bearings.	
		The connecting rods.	
		The crankshaft pin journals.	
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required.	
		The crankshaft bearings.	
		The crankshaft main journals.	
		The cylinder block.	
	Incorrect piston, piston pin and connecting rod installation	Verify the piston pins and connecting rods are installed correctly.	
		Repair as required.	
Engine noise under load.	Low oil pressure	Repair or replace as required.	
	Excessive connecting rod bearing clearance.	Inspect the following components and repair as required :	

	Excessive crankshaft bearing clearance.	<ul> <li>The connecting rod bearings.</li> <li>The connecting rods.</li> <li>The crankshaft.</li> </ul> Inspect the following components, and repair as required. <ul> <li>The crankshaft bearings.</li> <li>The crankshaft main journals.</li> </ul>
		The cylinder block.
Engine will not crank-crankshaft will not rotate.	<ul><li>Hydraulically locked cylinder.</li><li>Coolant/antifreeze in cylinder.</li><li>Oil in cylinder.</li><li>Fuel in cylinder.</li></ul>	<ul> <li>Remove spark plugs and check for fluid.</li> <li>Inspect for broken head gasket.</li> <li>Inspect for cracked engine block or cylinder head.</li> <li>Inspect for a sticking fuel injector and/or leaking fuel regulator.</li> </ul>
	Broken timing chain and/or timing chain and/or timing chain gears.	<ul><li>Inspect timing chain and gears.</li><li>Repair as required.</li></ul>
	Material in cylinder.  • Broken valve  • Piston material  • Foreign material	<ul> <li>Inspect cylinder for damaged components and/or foreign materials.</li> <li>Repair or replace as required.</li> </ul>
	Seized crankshaft or connecting rod bearings.	<ul><li>Inspect crankshaft and connecting rod bearing.</li><li>Repair as required.</li></ul>
	Bent or broken connecting rod.	<ul><li>Inspect connecting rods.</li><li>Repair as required.</li></ul>
	Broken crankshaft.	<ul><li>Inspect crankshaft.</li><li>Repair as required.</li></ul>



# Torque: N.m (kgf.m, lb-ft)

1.	. H	les	on	at	er

- 2. Air cleaner body
- 3. Air cleaner element

- 4. Air intake hose
- 5. Clamp

#### **REMOVAL AND INSTALLATION**

#### Air Cleaner Assembly

- 1. Remove the air cleaner upper cover.
  - (1) Disconnect the breather hose (A).
  - (2) Disconnect the intake hose (B).
  - (3) Remove the air cleaner upper cover (C).

#### **Tightening torque:**

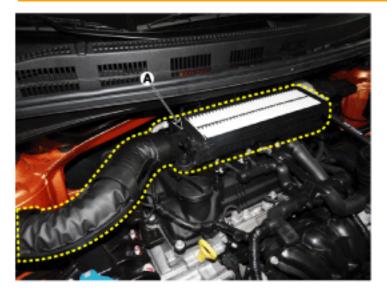
2.9 ~ 4.9 N.m (0.3 ~ 0.5 kgf.m, 2.2 ~ 3.6 lb-ft)



2. Remove the air cleaner assembly (A).

#### **Tightening torque:**

 $7.8 \sim 9.8 \text{ N.m}$  (0.8 ~ 1.0 kgf.m,  $5.8 \sim 7.2 \text{ lb-ft}$ )



3. Install in the reverse order of removal.

### Air Cleaner Element Replacement

- 1. Remove the air cleaner upper cover.
  - (1) Disconnect the intake hose clamp (A).
  - (2) Remove the air cleaner upper cover (B).

#### **Tightening torque:**

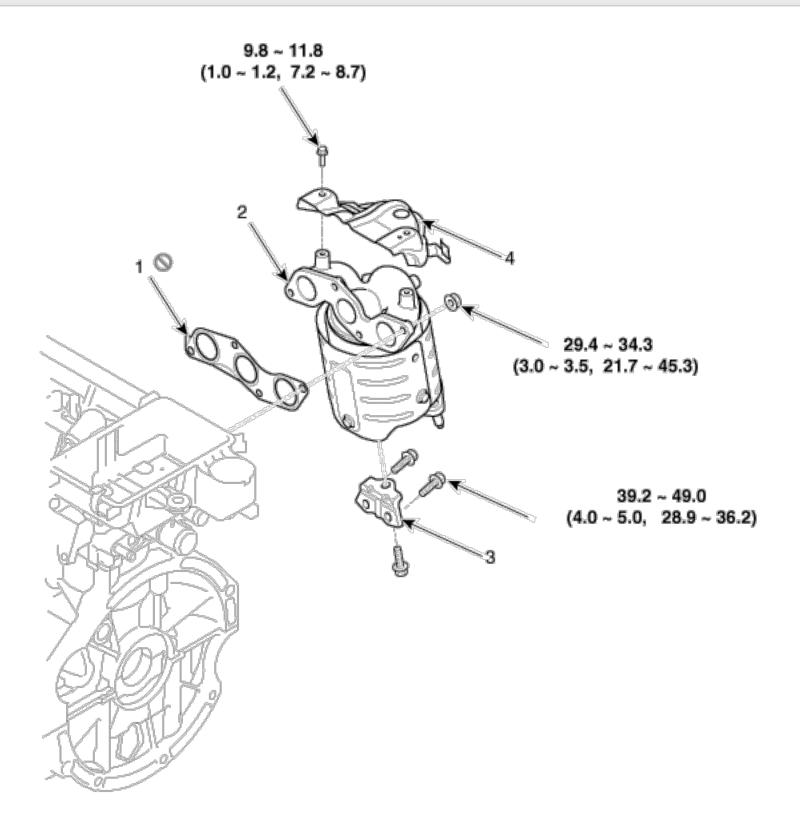
 $2.9 \sim 4.9 \text{ N.m}$  (0.3 ~ 0.5 kgf.m,  $2.2 \sim 3.6 \text{ lb-ft}$ )



2. Remove the air cleaner element replacement (A).



3. Install in the reverse order of removal.



# Torque: N.m (kgf.m, lb-ft)

	1.	Exhaust	manifold	gasket
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2. Exhaust manifold assembly

- 3. Exhaust manifold stay
- 4. Heat protector

#### **REMOVAL AND INSTALLATION**

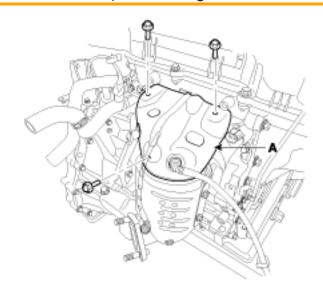
- Remove the air cleaner assembly.
   (Refer to Intake and Exhaust System "Air Cleaner")
- 2. Disconnect the negative battery terminal.
- 3. Disconnect the front oxygen sensor (A), rear oxygen sensor (B).



- 4. Remove the under cover.
- Remove the front muffler.(Refer to Intake and Exhaust System "Muffler")
- 6. Remove the exhaust manifold heat protector (A).

#### Tightening torque:

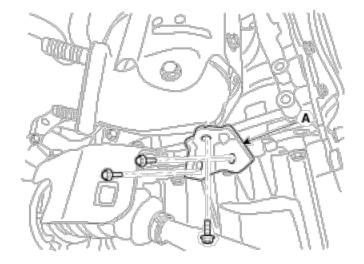
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



7. Remove the exhaust manifold stay (A).

#### Tightening torque:

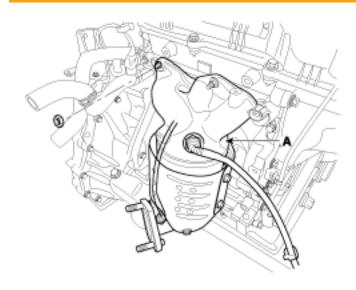
39.2 ~ 49.0 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.1 lb-ft)



8. Remove the exhaust manifold (A) with the gasket.

#### **Tightening torque:**

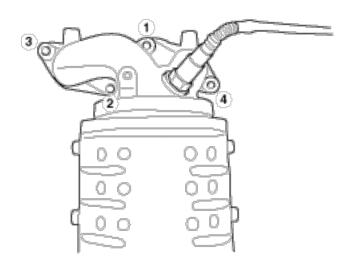
29.4 ~ 34.3 N.m (3.0 ~ 3.5 kgf.m, 21.7 ~ 45.3 lb-ft)



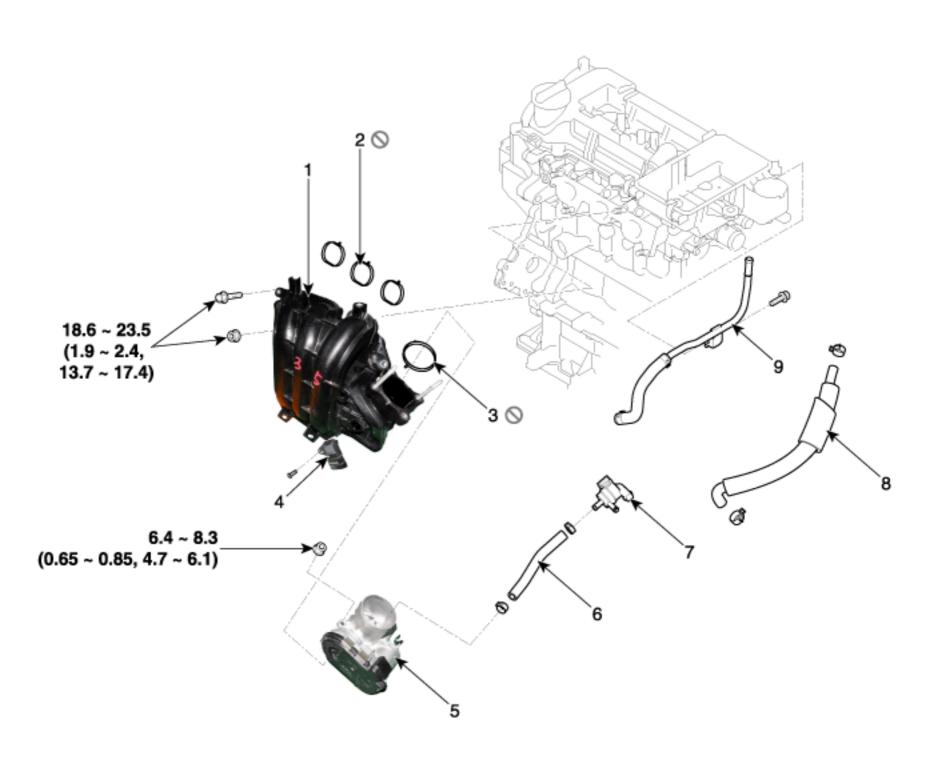
# NOTICE

When installing, replace with a new gasket.

When installing the intake manifold, tighten the nuts with pre-torque first, and then tighten the nuts with specified torque in the sequence shown.



9. Installation is reverse order of removal.



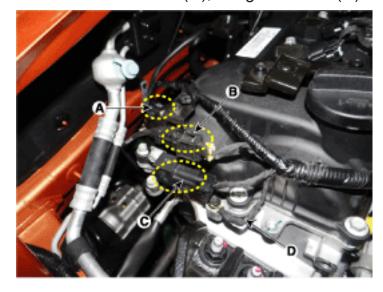
# Torque: N.m (kgf.m, lb-ft)

- 1. Intake manifold
- 2. Intake manifold gasket
- 3. Throttle body gasket
- 4. MAPS (Manifold Absolute Pressure Sensor)
- 5. Throttle body

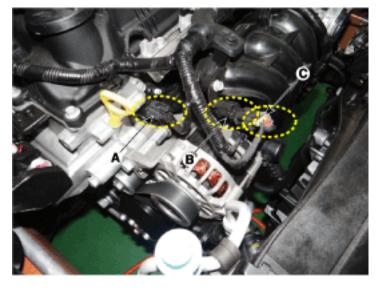
- 6. PCSV (Purge Control Solenoid Valve) hose
- 7. PCSV (Purge Control Solenoid Valve)
- 8. PCV (Positive Crankcase Ventlation) hose
- 9. Vacuum hose and pipe assembly

#### **REMOVAL AND INSTALLATION**

- Remove the air cleaner assembly.
   (Refer to Intake and Exhaust System "Air Cleaner")
- 2. Disconnect the negative battery terminal.
- 3. Disconnect the exhaust OCV(Oil Control Valve) connector (A).
- 4. Disconnect the front oxygen sensor connector (A), the CKPS (Crankshaft Position Sensor) connector (B), the condenser connector (C), the ground line (D).



5. Disconnect the intake OCV (Oil Control Valve) connector (A), the knock sensor connector (B), the alternator connector (C).

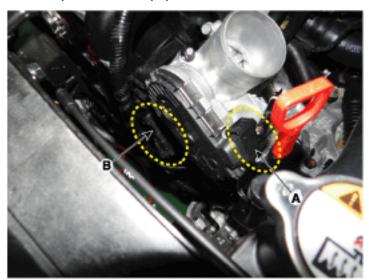


6. Disconnect the ignition coil connectors (A), the injector connectors (B), and then remove the wiring protector (C).

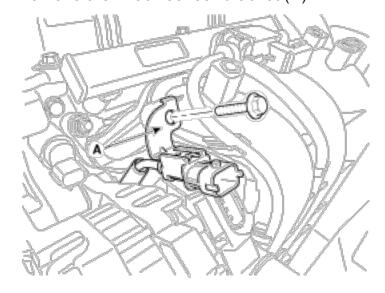


7. Disconnect the ETC (Electronic Throttle Control) connector (A), the MAPS (Manifold Absolute Pressure

Sensor)connector (B).



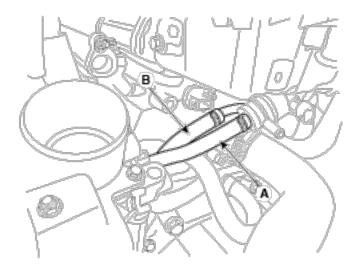
8. Remove the knock sensor bracket (A).



9. Disconnect the PCV (Positive Crankcase Ventilation) hose (A).



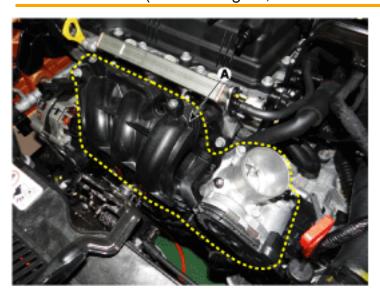
10. Disconnect the PCSV(Purge Control Solenoid Valve) hose (A) and the vacuum hose (B).



11. Remove the intake manifold (A) with the gasket.

### Tightening torque:

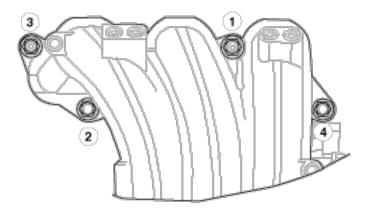
18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)



# NOTICE

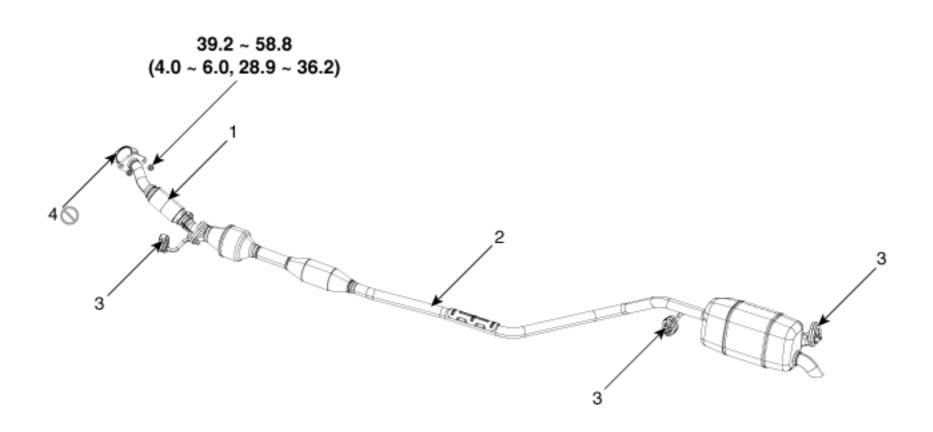
When installing, replace with new gaskets.

When installing the intake manifold, tighten the bolts and nuts with pre-torque first, and then tighten the bolts and nuts with specified torque in the sequence shown.



12. Installation is reverse order of removal.

# [EURO 6]



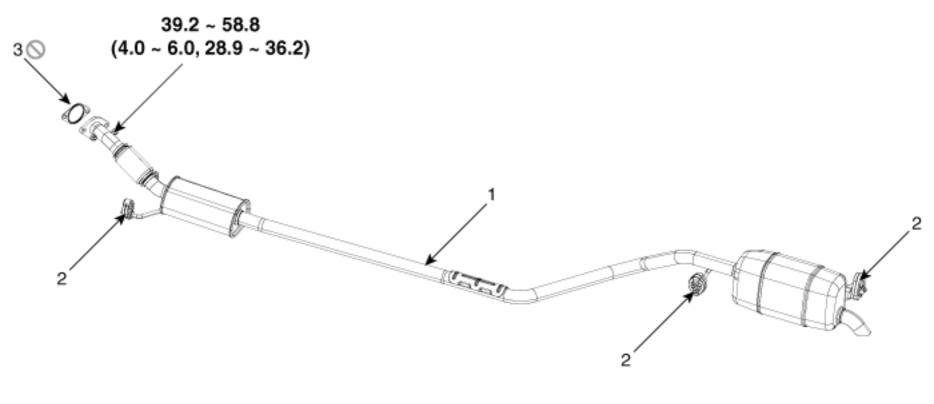
Tightening torque: N.m (kgf.m, lb-ft)

<ol> <li>Front</li> </ol>	muffler
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3. Hanger

2. Center muffler & Main muffler assembly

4. Gasket



# Tightening torque : N.m (kgf.m, lb-ft)

1. Muffler assembly	3. Gasket
2. Hanger	

#### **REMOVAL AND INSTALLATION**

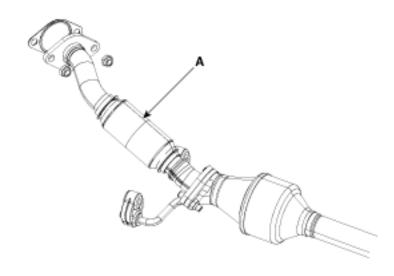
# [EURO 6]

### Front Muffler

1. Remove the front muffler (A).

#### **Tightening torque:**

40.0 ~ 60.0 N.m (4.1 ~ 6.1 kgf.m, 29.5 ~ 44.3 lb-ft)



2. Install in the reverse order of removal.

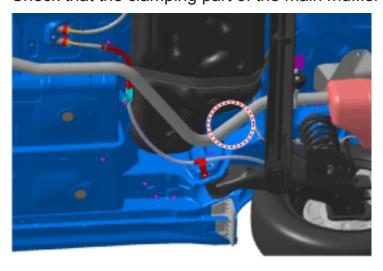
#### NOTICE

Always use new gaskets.

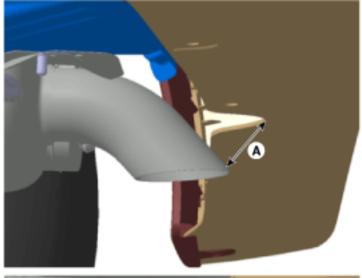
# Center Muffler & Main Muffler Assembly

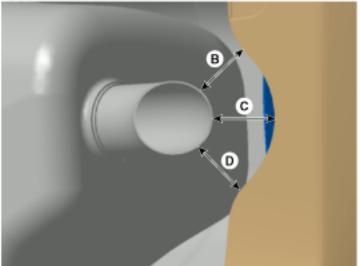
# Replacing procedures of catalytic converter using clamp

1. Check that the clamping part of the main muffler assembly is damaged or deformed.



2. Record the gap (A, B, C, D) between the tail pile and the rear bumper.

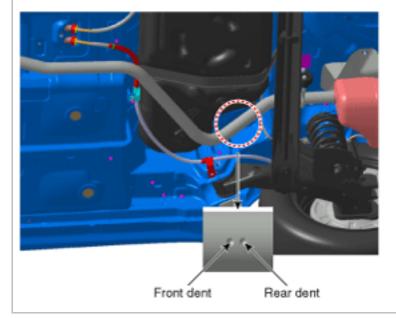




3. Cut the main muffler as indicated below.

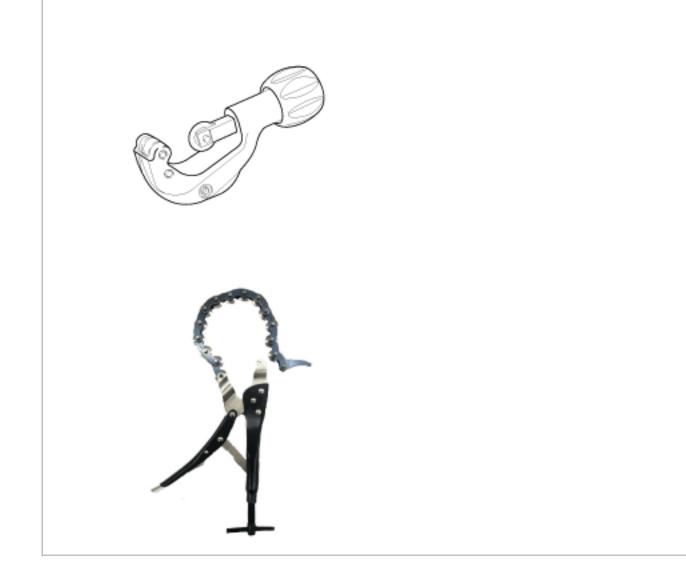
# NOTICE

- Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.
- Cut the muffler pipe marked with the rear dent.

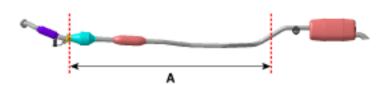


# i Information

• Use a pipe cutter or chain pipe cutter to make sure the cutting surface is smooth and even.

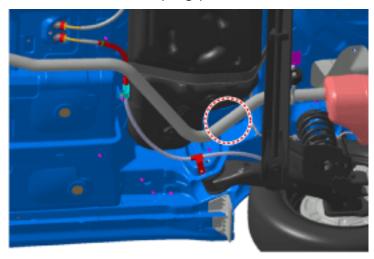


4. Replace the catalytic converter and center muffler (A) as shown in the image below. (Refer to the clamp installation procedures)

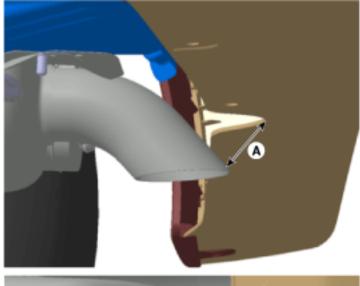


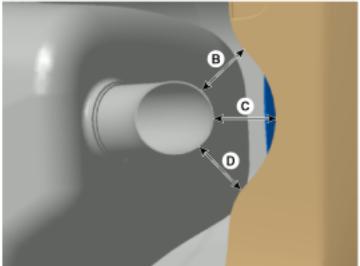
# Replacing procedures of center muffler including catalytic converter using clamp

1. Check that the clamping part of the main muffler assembly is damaged or deformed.



2. Record the gap (A, B, C, D) between the tail pile and the rear bumper.

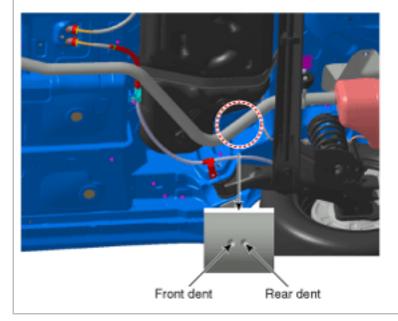




3. Cut the main muffler as the indicated below.

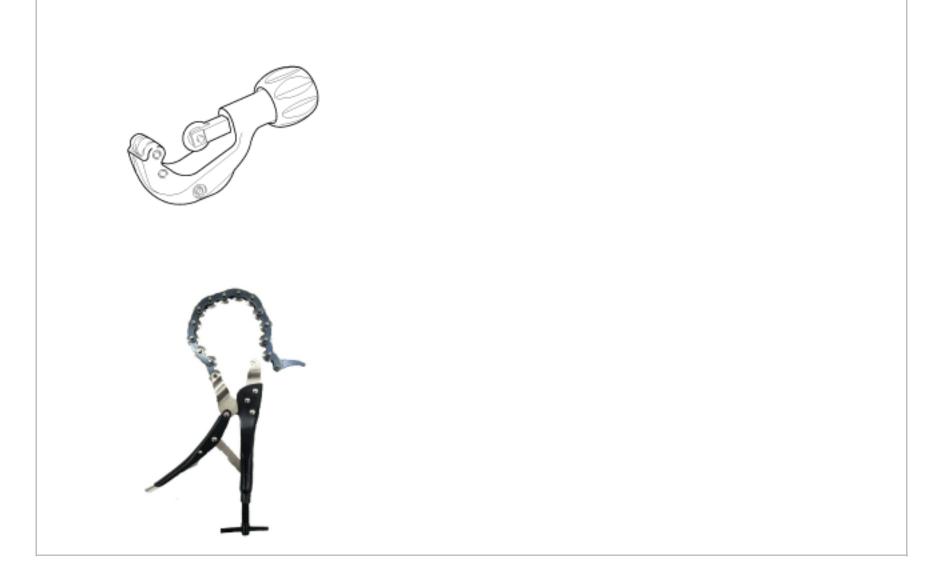
## NOTICE

- Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.
- Cut the muffler pipe marked with the rear dent.

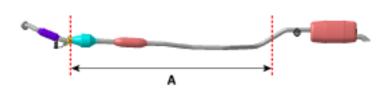


# i Information

• Use a pipe cutter or chain pipe cutter to make sure the cutting surface is smooth and even.



4. Replace the catalytic converter and center muffler (A) as shown in the image below. (Refer to the clamp installation procedures)

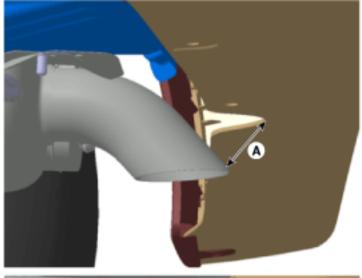


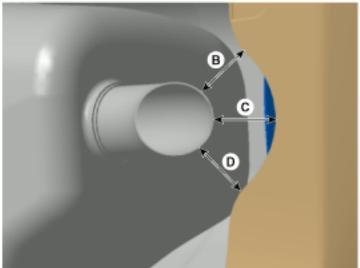
## Replacing procedures of center muffler without catalytic converter using clamp

1. Check that the clamping parts of the main and center muffler assembly.



2. Record the gap (A, B, C, D) between the tail pile and the rear bumper.

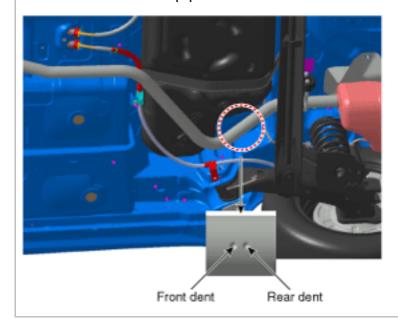




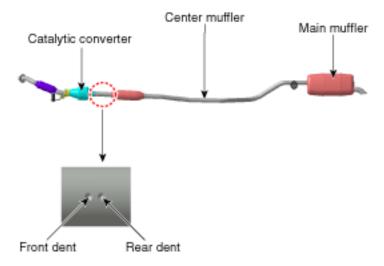
3. Cut the main muffler as indicated below.

# NOTICE

- Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.
- Cut the muffler pipe marked with the rear dent.



4. Cut the center muffler as indicated below.

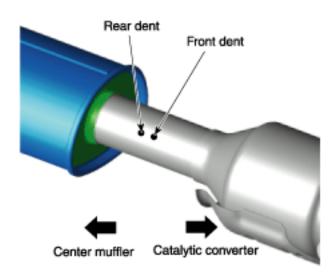


## NOTICE

• Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.

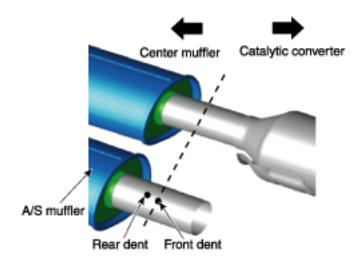
# [With dent]

Cut the muffler pipe marked with the front dent.



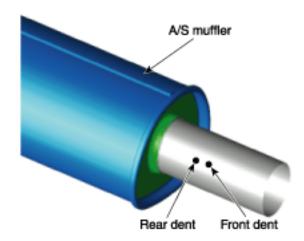
# [Without dent]

- Cut the muffler by reffering to the front dent of A/S muffler as shown in the image below.



# [A/S muffler]

- Cut the A/S muffler marked with the rear dent.



# NOTICE

- To prevent leaks, remove the rust on the clamping part or the burr on the cutting part.
- Cut the pipe vertically.

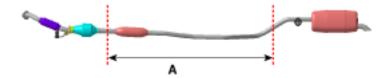
# information

• Use a pipe cutter or chain pipe cutter to make sure the cutting surface is smooth and even.



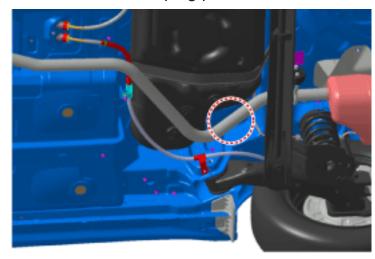


5. Replace the center muffler (A) as shown in the image below. (Refer to the clamp installation procedures)

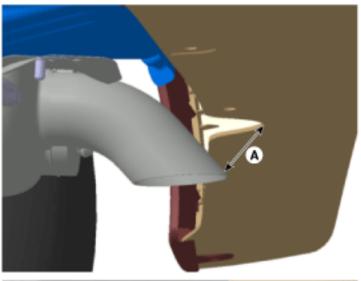


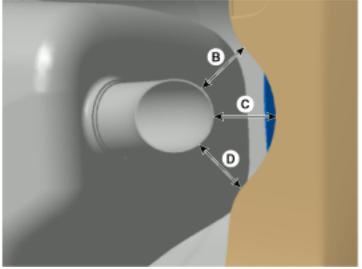
# Replacing procedures of main muffler using clamp

1. Check that the clamping part of the main muffler assembly is damaged or deformed.



2. Record the gap (A, B, C, D) between the tail pile and the rear bumper.

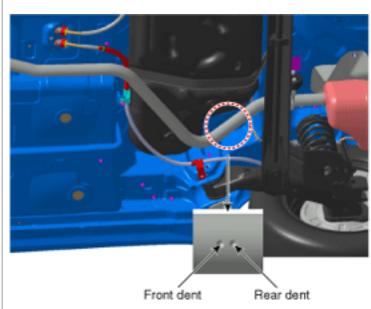




3. Cut the main muffler as indicated below.



- Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.
- Cut the muffler pipe marked with the front dent.



# i Information

• Use a pipe cutter or chain pipe cutter to make sure the cutting surface is smooth and even.



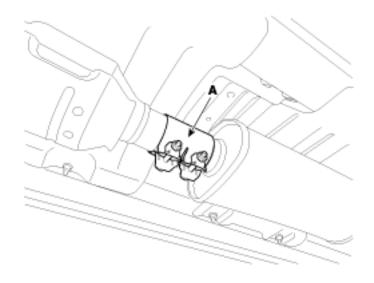


4. Replace the main muffler (A) as shown in the image below. (Refer to the clamp installation procedures)



## Clamp installation procedures when replacing the catalytic converter and center muffler

1. Put the clamp (A) between the cutting parts of the pipe and tighten the clamp lightly, not completely.

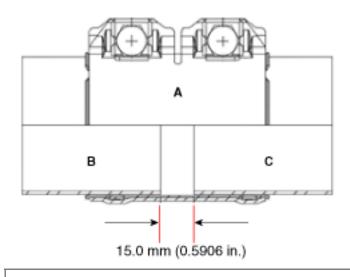


## NOTICE

Do not reuse the clamp that was tightened completely. If reused, the clamp may cause leaks.

#### NOTICE

In order to protect any leak from the clamp connection, the connection point of the two mufflers must be located within 7.5mm (0.3in.) from the clamp center line.



A: Clamp

B : Catalytic converter

C: Center muffler

2. Compare the gap between the tail pipe (or tail trim) and the rear bumper with the record measured before removing the center muffler assembly.

## **NOTICE**

If the tail pipe position is different from the initial position, the bumper may be damaged by the pipe heat and noise which arise from the interference between the tail pipe and the rear bumper.

3. Do not tighten the clamp by turning it once. Tighten the clamp nuts with the specified torque by alternately turning them a couple of times.

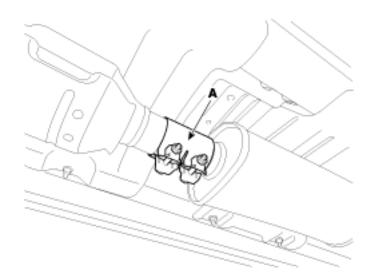
## Tightening torque:

[Part No: 28641-C8381]

41.2 ~ 54.9 N.m (4.2 ~ 5.6 kgf.m, 30.4 ~ 40.5 lb-ft)

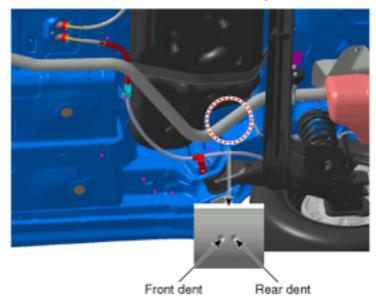
[Part No: 28641-C8420]

17.7 ~ 23.5 N.m (1.8 ~ 2.4 kgf.m, 13.0 ~ 17.4 lb-ft)



# Clamp installation procedures when replacing the main muffler and center muffler

1. Put the clamp between the cutting parts of the pipe and tighten the clamp lightly, not completely.

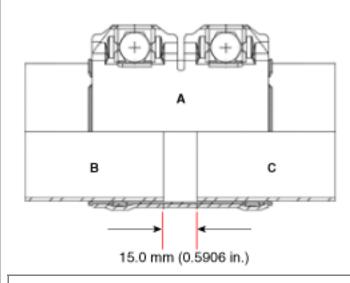


### NOTICE

Do not reuse the clamp that was tightened completely. If reused, the clamp may cause leaks.

### NOTICE

In order to protect any leak from the clamp connection, the connection point of the two mufflers must be located within 7.5mm (0.3in.) from the clamp center line.



A: Clamp

B : Center muffler C : Main muffler

2. Compare the gap between the tail pipe (or tail trim) and the rear bumper with the record measured before removing the center muffler assembly.

### NOTICE

If the tail pipe position is different from the initial position, the bumper may be damaged by the pipe heat and noise which arise from the interference between the tail pipe and the rear bumper.

3. Do not tighten the clamp by turning it once. Tighten the clamp nuts with the specified torque by alternately turning them a couple of times.

#### Tightening torque:

[Part No: 28641-C8381]

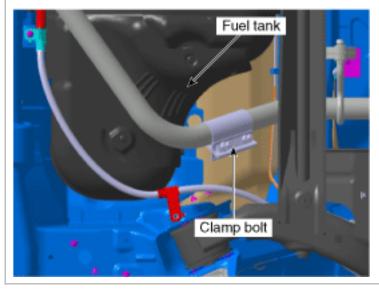
41.2 ~ 54.9 N.m (4.2 ~ 5.6 kgf.m, 30.4 ~ 40.5 lb-ft)

[Part No: 28641-C8420]

17.7 ~ 23.5 N.m (1.8 ~ 2.4 kgf.m, 13.0 ~ 17.4 lb-ft)

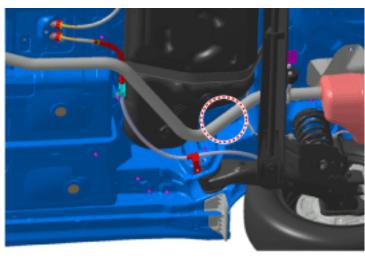
### **NOTICE**

The clamp bolt should place opposite side of the fuel tank.

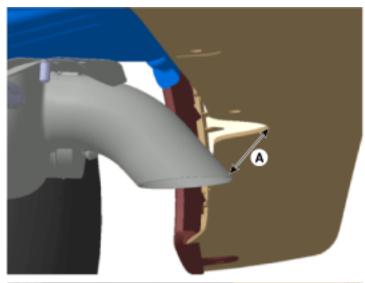


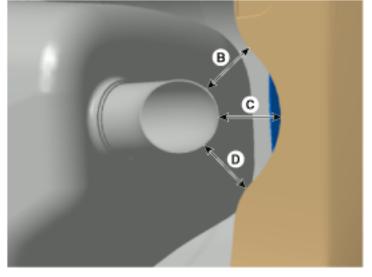
# Replacing procedures of front muffler & center muffler assembly using clamp

1. Check that the clamping part of the main muffler assembly is damaged or deformed.



2. Record the gap (A, B, C, D) between the tail pile and the rear bumper.

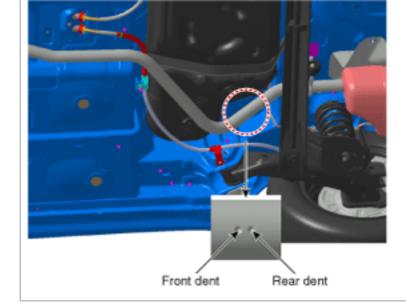




3. Cut the main muffler as indicated below.

# NOTICE

- Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.
- Cut the muffler pipe marked with the rear dent.



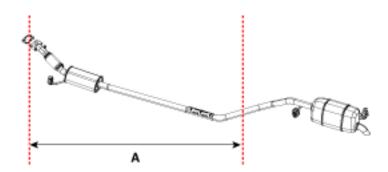
# i Information

• Use a pipe cutter or chain pipe cutter to make sure the cutting surface is smooth and even.





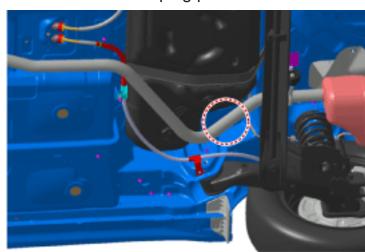
4. Replace the front muffler & center muffler assembly (A) as shown in the image below. (Refer to the clamp installation procedures)



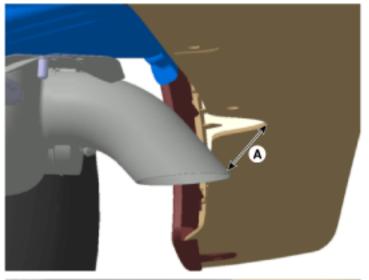
## Main muffler

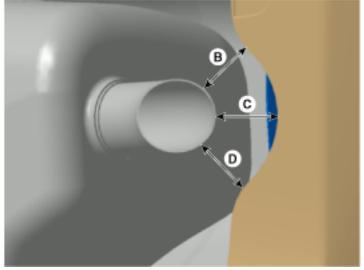
# Replacing procedures of main muffler using clamp

1. Check that the clamping part of the main muffler assembly is damaged or deformed.



2. Record the gap (A, B, C, D) between the tail pile and the rear bumper.

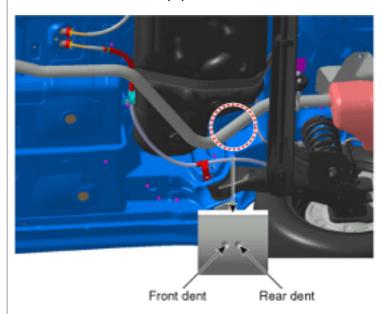




3. Cut the main muffler as indicated below.

## **NOTICE**

- Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.
- Cut the muffler pipe marked with the front dent.



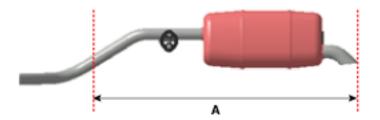


• Use a pipe cutter or chain pipe cutter to make sure the cutting surface is smooth and even.



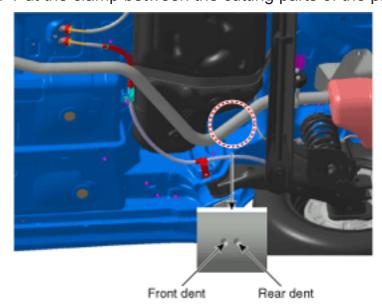


4. Replace the main muffler (A) as shown in the image below. (Refer to the clamp installation procedures)



# Clamp installation procedures when replacing the main muffler

1. Put the clamp between the cutting parts of the pipe and tighten the clamp lightly, not completely.

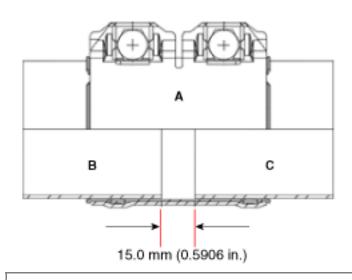


## NOTICE

Do not reuse the clamp that was tightened completely. If reused, the clamp may cause leaks.

### NOTICE

In order to protect any leak from the clamp connection, the connection point of the two mufflers must be located within 7.5mm (0.3in.) from the clamp center line.



A: Clamp

B: Center muffler

C: Main muffler

2. Compare the gap between the tail pipe(or tail trim) and the rear bumper with the record measured before removing

the center muffler assembly.

## NOTICE

- If the tail pipe position is different from the initial position, the bumper may be damaged by the pipe heat and noise which arise from the interference between the tail pipe and the rear bumper.
- 3. Do not tighten the clamp by turning it once. Tighten the clamp nuts with the specified torque by alternately turning them a couple of times.

#### Tightening torque:

[Part No: 28641-C8381]

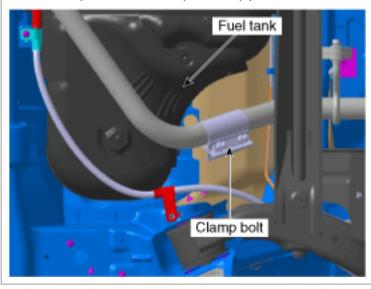
41.2 ~ 54.9 N.m (4.2 ~ 5.6 kgf.m, 30.4 ~ 40.5 lb-ft)

[Part No: 28641-C8420]

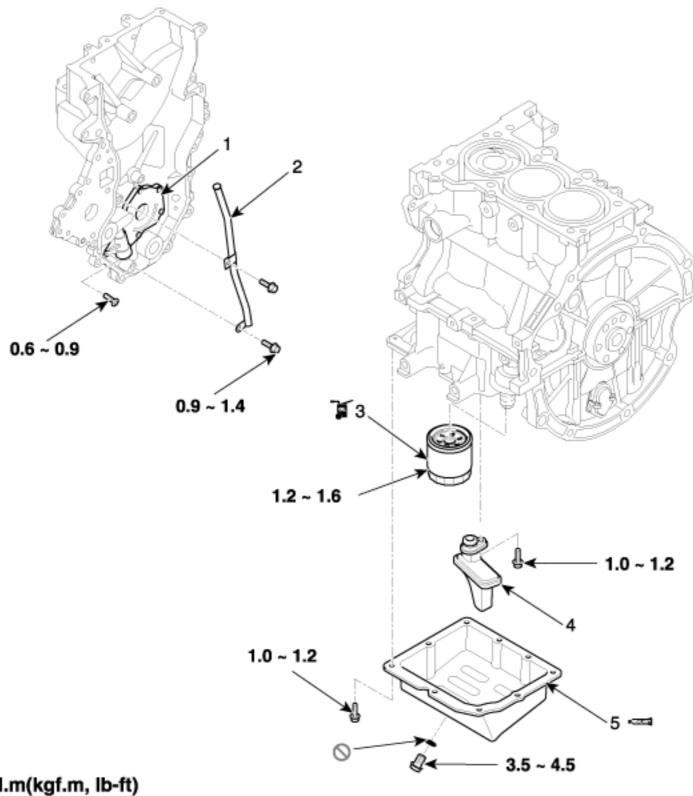
17.7 ~ 23.5 N.m (1.8 ~ 2.4 kgf.m, 13.0 ~ 17.4 lb-ft)

## NOTICE

The clamp bolt should place opposite side of the fuel tank.



## **COMPONENTS**



Torque : N.m(kgf.m, lb-ft)

- 1. Oil Pump
- 2. Oil level gauge guide
- 3. Oil filter

- 4. Oil screen
- 5. Oil pan

#### **ENGINE OIL AND FILTER REPLACEMENT**

## **▲** CAUTION

- Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.
- Exercise caution in order to minimize the length and frequency of contact of your skin to used oil. Wear
  protective clothing and gloves. Wash your skin thoroughly with soap and water, or use water-less hand
  cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.
- In order to preserve the environment, used oil and used oil filter must be disposed of only at designated disposal sites.
- 1. Drain the engine oil.
  - (1) Remove the oil filler cap.
  - (2) Remove the oil drain plug (A) and drain the oil into a container.
  - (3) Clean and install the oil drain plug with a new gasket.

### **Tightening torque:**

34.3 ~ 44.1 N.m (3.5 ~ 4.5 kgf.m, 25.3 ~ 32.5 lb-ft)

- 2. Replace the oil filter.
  - (1) Remove the oil filter (A) with the SST (09263-02000).
  - (2) Check and clean the oil filter installation surface.
  - (3) Check the part number of the new oil filter is as same as old one.
  - (4) Apply clean engine oil to the gasket of a new oil filter.
  - (5) Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.
  - (6) Tighten it with the torque below.

#### **Tightening torque:**

11.8 ~ 15.7 N.m (1.2 ~ 1.6 kgf.m, 8.7 ~ 11.6 lb-ft)



3. Fill with new engine oil, after removing the engine oil level gauge.

#### Oil capacity

Total: 3.3L (3.48 US qt, 2.90 lmp.qt)
Oil pan: 2.7L (2.85 US qt, 2.37 lmp qt)
Drain and refill including oil filter:
3.0L (3.17 US qt, 2.64 lmp.qt)

- 4. Install the oil filler cap.
- 5. Start engine and check for oil leaks.
- 6. Recheck the engine oil level.

#### **INSPECTION**

- 1. Check the engine oil quality.
  - Check for oil deterioration, entry of water, discoloring of thinning.
  - If the quality is visibly poor, replace the oil.
- 2. Check the engine oil level.
  - After warming up the engine for five minutes, stop the engine and check the oil level. The level should be between the "L" and "F" marks on the dipstick.
  - If low, check for oil leakage and add oil up to the "F" mark on the dipstick.

## Selection of Engine Oil

#### Recommendation

For all except Middle East, India and Europe:

ACEA A5, API SM or above / 5W-30

For Middle East, India and Europe:

ACE A5, API SM or above / 5W-30

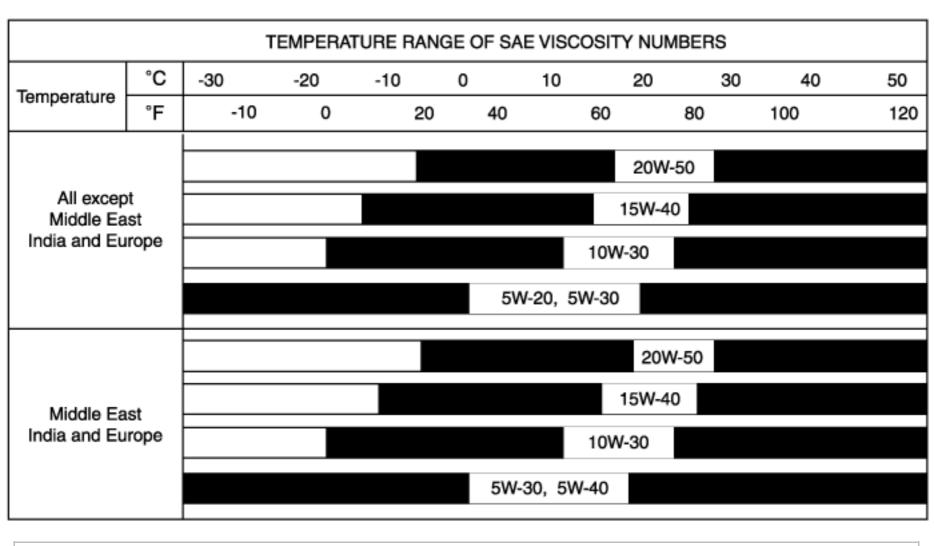
#### Allowed Oil Grade

API SL, SM or above

ILSAC GF-3, GF4 or above

ACEA A3, A5 or above

Allowed SAE Viscosity



## NOTICE

For best performance and maximum protection of all types of operation, select only those lubricants which:

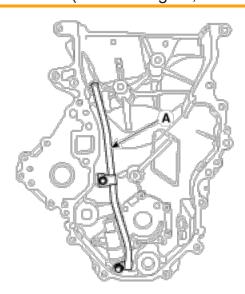
- 1) Satisfy the requirement of the API or ILSAC classification.
- 2) Have proper SAE grade number for expected ambient temperature range.
- 3) Lubricants that do not have both an SAE grade number and API or ILSAC service classification on the container should not be used.

## **REMOVAL AND INSTALLATION**

- Remove the timing chain cover.
   (Refer to Timing System "Timing Chain Cover")
- 2. Remove the oil level gauge (A).

# Tightening torque :

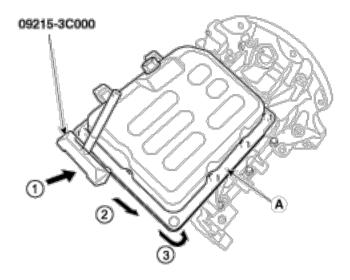
 $8.8 \sim 13.7 \text{ N.m} (0.9 \sim 1.4 \text{ kgf.m}, 6.5 \sim 10.1 \text{ lb-ft})$ 



3. Install in the reverse order of removal.

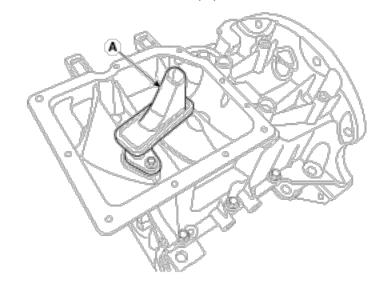
#### **REMOVAL**

- Remove the under covers.
   (Refer to Engine and Transaxle Assembly "Engine Room Under Cover")
- Drain engine oil.
   (Refer to Lubrication System "Engine Oil")
- 3. Remove the oil pan (A). Insert the blade of SST (09215-3C000) between the ladder frame and the oil pan. Cut off applied sealer and remove the oil pan.



## **NOTICE**

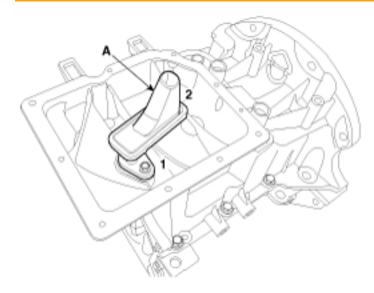
- Insert the SST between the ladder frame and the oil pan by tapping it with a plastic hammer in the direction of (1) arrow.
- After tapping the SST with a plastic hammer along the direction of (2) arrow around more than 2/3 edge of the oil pan, remove it from the oil pan.
- Do not turn over the SST abruptly without tapping. It be result in damage of the SST.
- Be careful not to damage the contact surfaces of ladder frame and oil pan.
- 4. Remove the oil screen (A).



1. Install the oil screen (A), with a new O-ring.

## Tightening torque:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

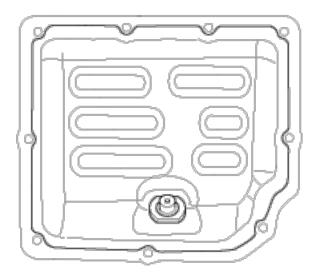


## **NOTICE**

Before installing the oil screen, apply a coat of engine oil to the O-ring.

- 2. Install the lower oil pan.
  - (1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
  - (2) Before assembling the oil pan, the liquid sealant TB1217H or LT5900H should be applied on lower oil pan. The part must be assembled within 5 minutes after the sealant was applied.

**Bead width:** 3.0 ~ 4.0 mm (0.12 ~ 0.16 in)



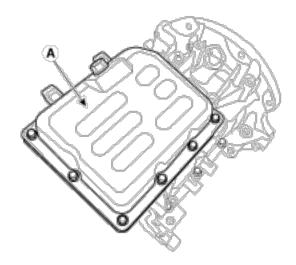
## **NOTICE**

- Clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant.
- When applying sealant gasket, sealant must not protrude into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.
- 3. Install the lower oil pan (A).

#### **Tightening torque:**

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

Uniformly tighten the bolts in several passes.



# NOTICE

After assembly, wait at least 30 minutes before filling the engine with oil. Always use a new drain plug gasket.

4. Refill engine with engine oil.

#### **REMOVAL AND INSTALLATION**

1. Disconnect the oil pressure switch connector (A) and then remove the oil pressure switch (B).

### Tightening torque:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



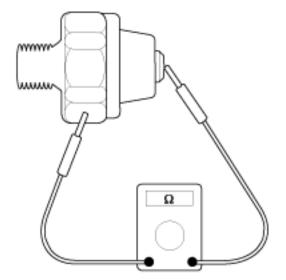
2. Install in the reverse order of removal.

## NOTICE

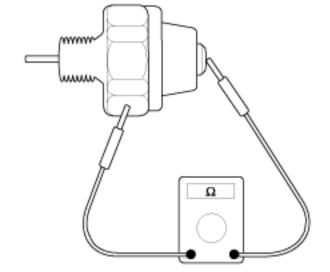
When installing the oil pressure switch, apply seal lock to the thread.

#### **INSPECTION**

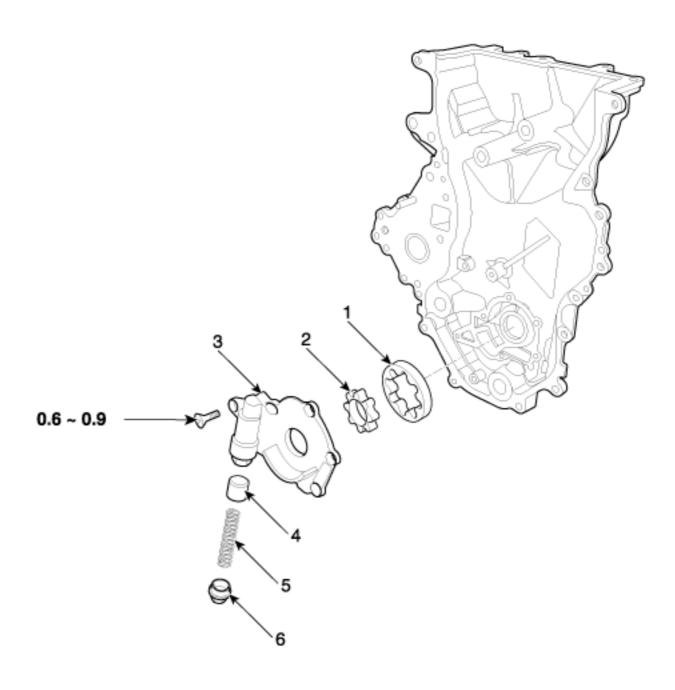
1. Check the continuity between the terminal and the body with an ohmmeter. If there is no continuity, replace the oil pressure switch.



- 2. Check the continuity between the terminal and the body when the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.
- 3. If there is no continuity when a 50kPa (0.50kgf/cm², 7.25psi) is applied through the oil hole, the switch is operaing properly.
  - Check for air leakage. If air leaks, the diaphragm is broken. Replace it.



# **COMPONENTS**



# Torque : N.m(kgf.m, lb-ft)

1. Outer rotor	4. Plug
2. Inner rotor	5. Spring
3. Oil pump cover	6. Relief plunger

## Engine Mechanical System > Lubrication System > Oil Pump > Repair procedures

#### **REMOVAL AND INSTALLATION**

- Remove the timing chain cover.
   (Refer to Timing system "Timing Chain Cover")
- Remove the oil level gauge guide.
   (Refer to Lubrication System "Oil Level Gauge & Pipe")
- 3. Remove the oil pump cover (A), the inner rotor (B) and the outer rotor (C).

### Tightening torque:

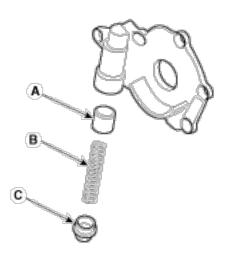
 $5.9 \sim 8.8$ N.m (0.6  $\sim 0.9$ kgf.m,  $4.3 \sim 6.5$ lb-ft)



- 4. Installation is the reverse order of removal.
- 5. Refill the engine oil.

#### **INSPECTION**

Remove the relief plunger.
 Remove the plug (A), spring (B) and relief plunger (C).



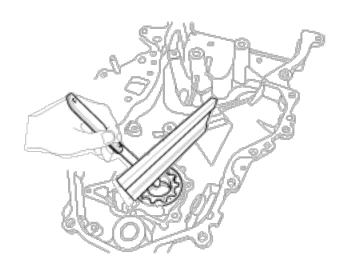
Inspect the relief plunger.
 Coat the plunger with engine oil and check that it falls smoothly into the plunger hole by its own weight.
 If necessary, replace timing chain cover.

Inspect the rotor side clearance.
 Using a feeler gauge and precision straight edge, measure the clearance between the inner rotors and precision straight edge.

If the side clearance is greater than maximum, replace the rotors as a set. If necessary, replace the timing chain cover.

#### Side clearance:

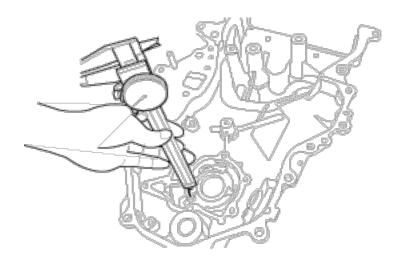
0.040 ~ 0.090 mm (0.00157 ~ 0.00354 in.)



Inspect the oil pump boby width.
 Using a vernier calipers, measure the width of oil pump body.
 If necessary, replace the timing chain cover.

## **Body width:**

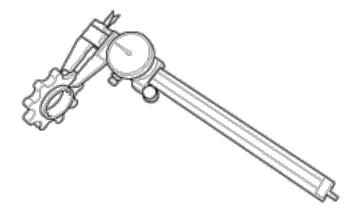
7.02 ~ 7.05 mm (0.2763 ~ 0.2775 in.)



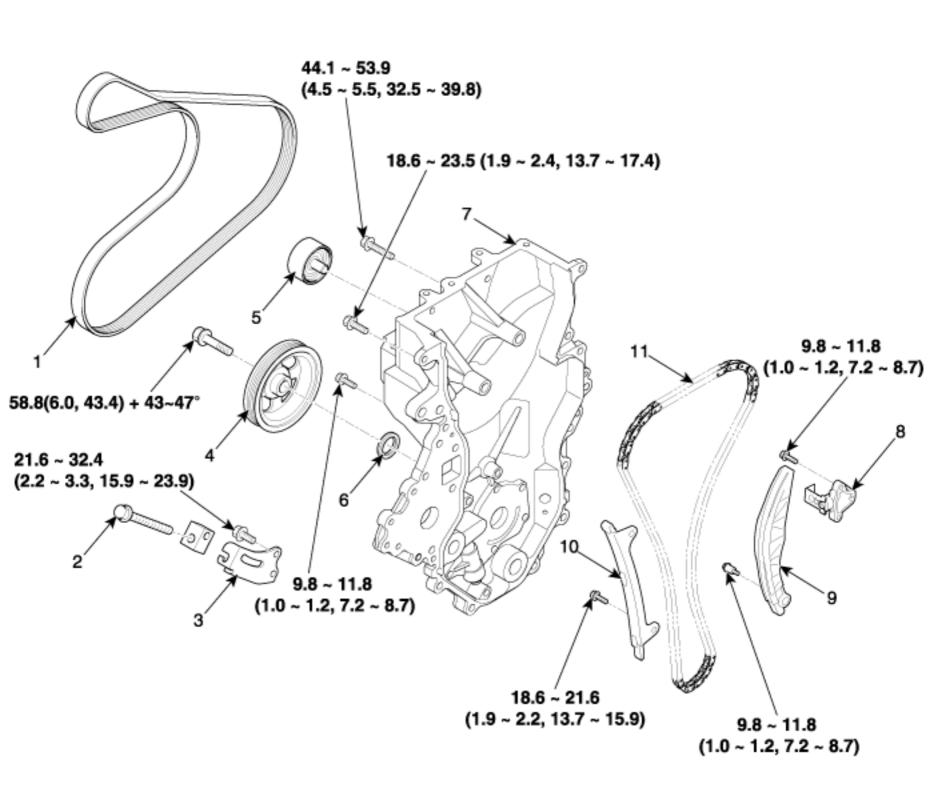
Inspect the inner rotor width.Using a vernier calipers, measure the width of inner rotor.If necessary, replace the rotor.

## Inner rotor width:

6.96 ~ 6.98 mm (0.2740 ~ 0.2748 in.)



## **COMPONENTS**

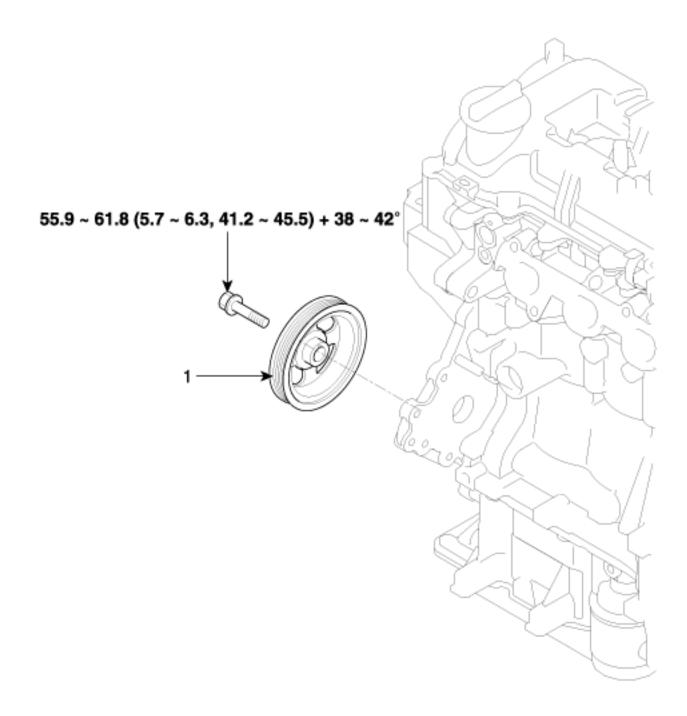


## Torque: N.m (kgf.m, lb-ft)

- 1. Drive belt
- 2. Tension adjusting bolt
- 3. Alternator brace
- 4. Crankshaft damper pulley
- 5. Idler
- 6. Front oil seal

- 7. Timing chain cover
- 8. Timing chain tensioner
- 9. Timing chain tensioner arm
- 10. Timing chain guide
- 11. Timing chain

# COMPONENTS

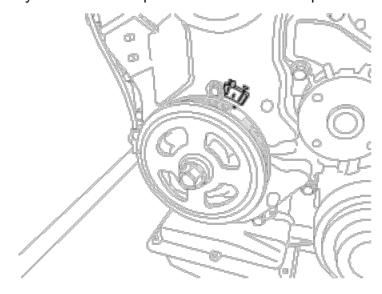


Torque : N.m (kgf.m, lb-ft)

Crankshaft damper pulley.	
---------------------------	--

### **REMOVAL AND INSTALLATION**

- 1. Remove the passenger seat RH front tire.
- 2. Remove the engine room under cover.
- 3. Turn the crankshaft pulley and align its groove with the timing mark of the timing chain cover to set the piston of No.1 cylinder to the top dead center on compression stroke.

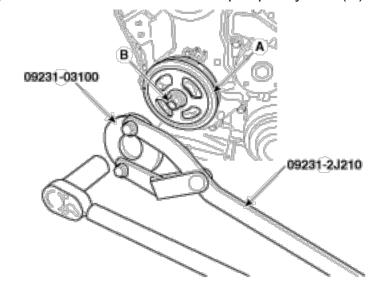


4. Remove the crankshaft damper pulley.

#### Tightening torque:

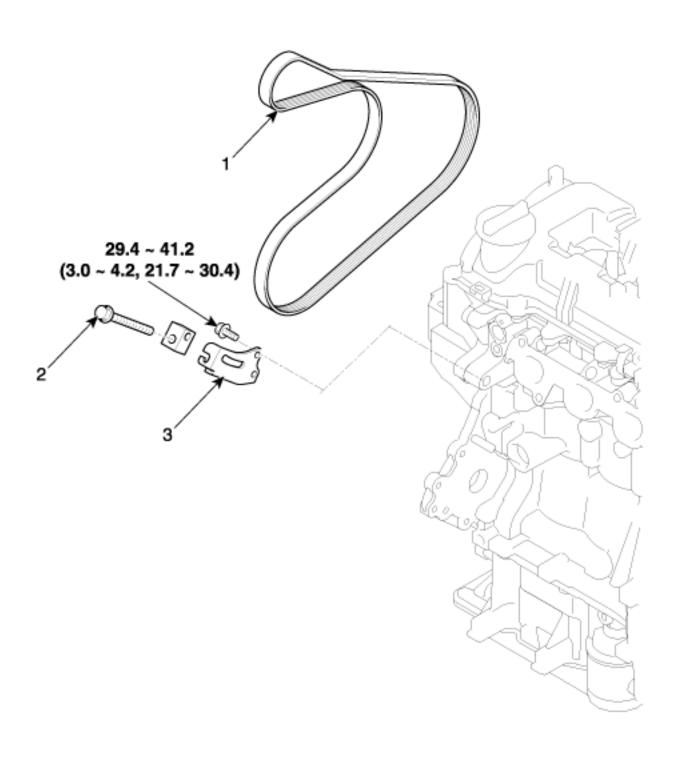
 $55.9 \sim 61.7 \text{ N.m} (5.7 \sim 6.3 \text{ kgf.m}, 41.2 \sim 45.5 \text{ lb-ft}) + 38 \sim 42^{\circ}$ 

- (1) Using the SST (09231-03100, 09231-2J210) to hold the crankshaft damper pulley (A).
- (2) Remove the crankshaft damper pulley bolt (B) and then remove the crankshaft damper pulley (A).



5. Install in the reverse order of removal.

# **COMPONENTS**



# Torque : N.m (kgf.m, lb-ft)

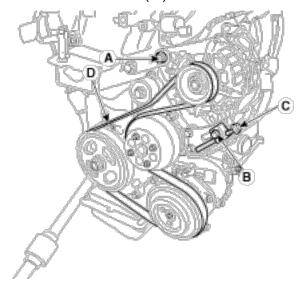
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2. Adjusting bolt

3. Alternator brace

### **REMOVAL AND INSTALLATION**

- 1. Remove the passenger seat RH front tire.
- 2. Remove the drive belt (A).
  - (1) Loosen the alternator mounting bolts (A, B).
  - (2) Loosen the tension by turning the tension adjusting bolt (C) counterclockwise.
  - (3) Remove the drive belt (D).



## **INSTALLATION**

1. Install the drive belt (A).

#### [Full-option type]

- (1) Install the drive belt (D).
- (2) Adjust the tension by turning the tension adjusting bolt (C) clockwise.

#### **Belt tension**

New belt:

980.7 ~ 1078.7 N.m (100.0 ~ 110.0 kgf.m, 220.5 ~ 242.5 lb-ft)

Used bel t:

676.7 ~ 774.7 N.m (69.0 ~ 79.0 kgf.m, 152.1 ~ 174.2 lb-ft)

(3) Fasten the alternator mounting bolts (A, B).

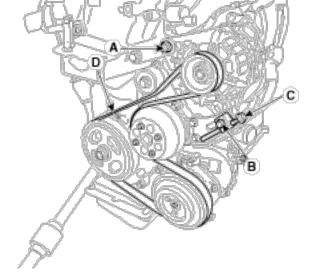
#### **Tightening torque**

Bolt (A):

29.4 ~ 41.2 N.m (3.0 ~ 4.2 kgf.m, 21.7 ~ 30.4 lb-ft)

Bolt (B)

21.6 ~ 32.4 N.m (2.2 ~ 3.3 kgf.m, 15.9 ~ 23.9 lb-ft)

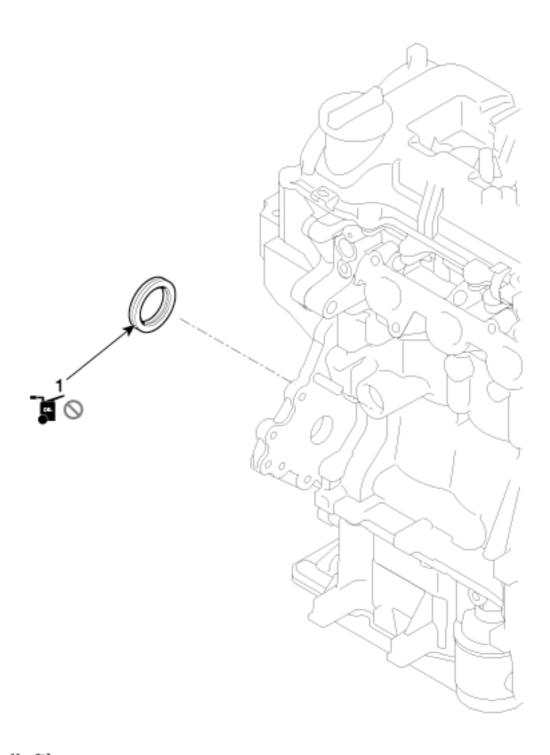


2. Install the passenger seat RH front tire.

# NOTICE

The belt must be free from any harmful damage during installation.

# **COMPONENTS**

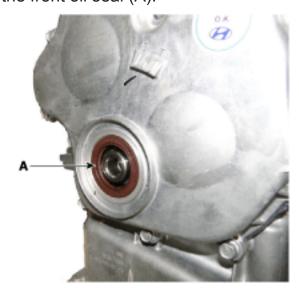


# Torque : N.m(kgf.m, lb-ft)

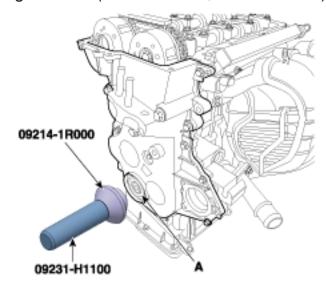
1. Front Oil Seal	
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### **REMOVAL AND INSTALLATION**

- Remove the crankshaft damper pulley.
   (Refer to Timing System "Crankshaft Damper Pulley")
- 2. Remove the front oil seal (A).



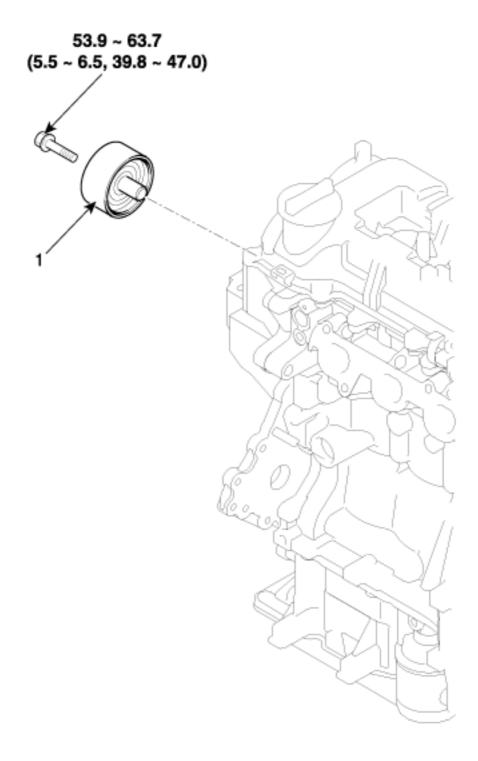
3. Using the SST (09214-1R100, 09231-H1100) (A), install a new front oil seal (B).



# NOTICE

Do not reuse the front oil seal.

# **COMPONENTS**



Torque : N.m (kgf.m, lb-ft)

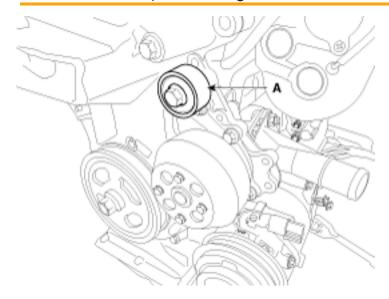
1. Idler

# **REMOVAL AND INSTALLATION**

- Remove the drive belt.
   (Refer to Timing System "Drive Belt")
- 2. Remove the drive belt idler (A).

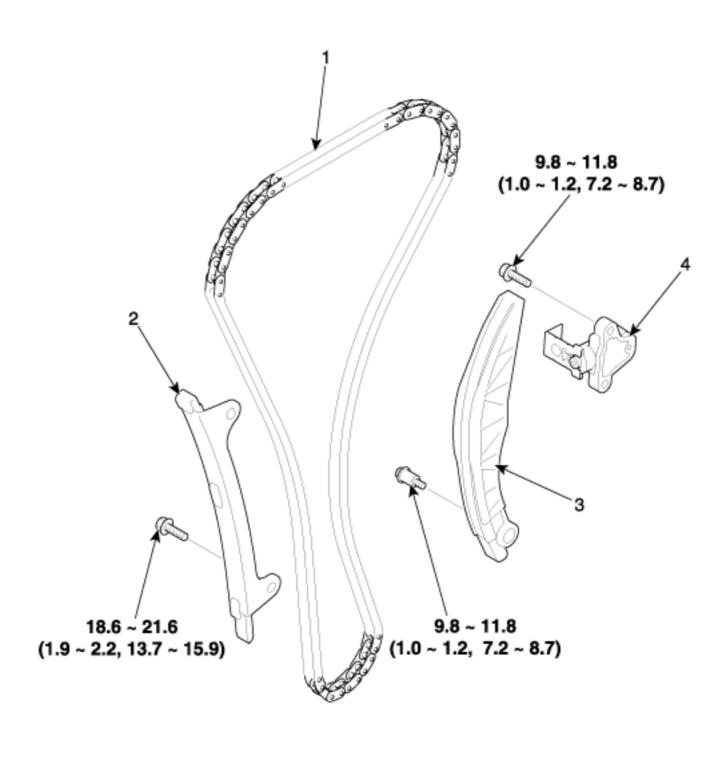
# Tightening torque:

 $53.9 \sim 63.7 \text{ N.m} (5.5 \sim 6.5 \text{ kgf.m}, 39.8 \sim 47.0 \text{ lb-ft})$ 



3. Install in the reverse order of removal.

# **COMPONENTS**



# Torque : N.m(kgf.m, lb-ft)

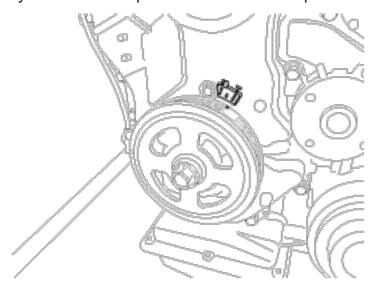
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2. Timing chain guide

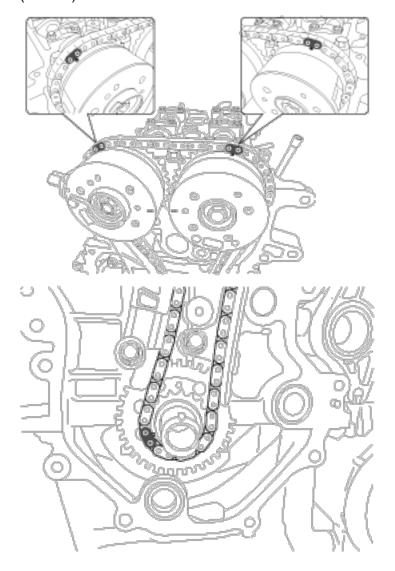
- 3. Timing chain tensioner arm
- 4. Timing chain tensioner

### **REMOVAL**

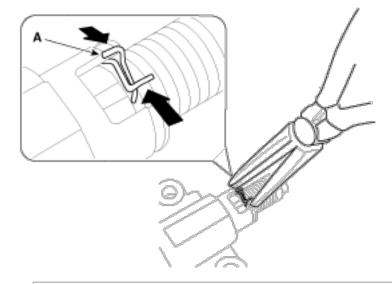
- Remove the cylinder head cover.
   (Refer to Cylinder Head Assembly "Cylinder Head Cover")
- 2. Turn the crankshaft pulley and align its groove with the timing mark of the timing chain cover to set the piston of No.1 cylinder to the top dead center on compression stroke.



- Remove the timing chain cover.
   (Refer to Timing System "Timing Chain Cover")
- 4. Before removing the timing chain, mark the timing chain with an identification based on the location of the sprocket (CVVT) because the identification mark on the chain for TDC (Top Dead Center) can be erased.

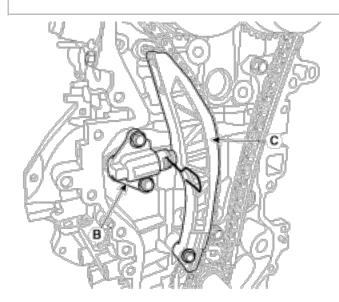


5. Install a set pin after compressing the timing chain tensioner by hold the ratchet clip (A), Then remove the tensioner (B) and the tensioner arm (C).

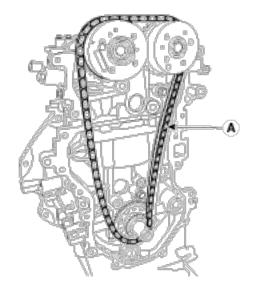


# **▲** CAUTION

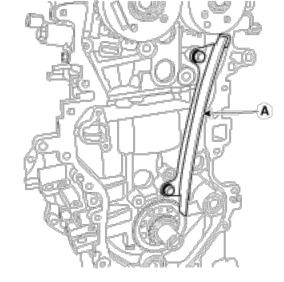
- Insert a set pin surely and keep the tensioner clean.
- Keep the tensioner clean.
- Once disassemble the inner parts of tensioner, should not be used.



6. Remove the timing chain (A).



7. Remove the timing chain guide (A).



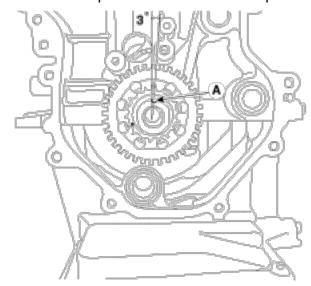
#### **INSPECTION**

### Sprockets, Chain Tensioner, Chain Guide, Chain Tensioner Arm

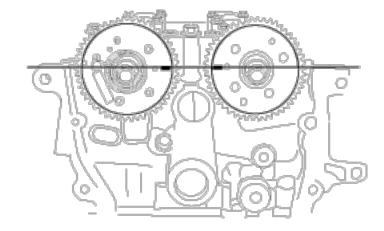
- 1. Check the camshaft sprocket and crankshaft sprocket for abnormal wear, cracks, or damage. Replace as necessary.
- 2. Inspect the tensioner arm and chain guide for abnormal wear, cracks, or damage. Replace as necessary.
- 3. Check that the tensioner piston moves smoothly.

### **INSTALLATION**

1. Set the dowel pin (A) of crankshaft about 3° with virtical center line. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.



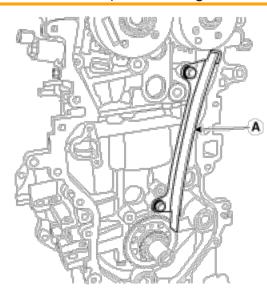
2. Align the mark of CVVT on the top surface of cylinder head. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.



3. Install the timing chain guide (A).

### Tightening torque:

18.6 ~ 21.6 N.m (1.9 ~ 2.2 kgf.m, 13.7 ~ 15.9 lb-ft)



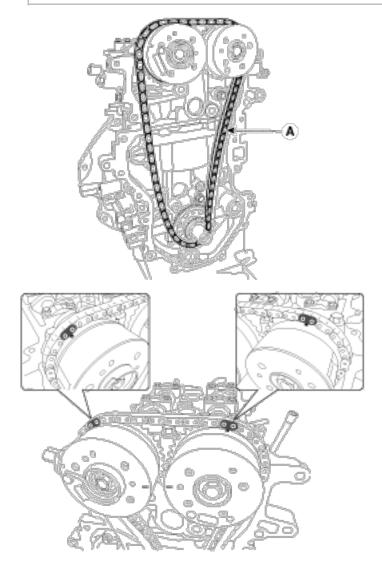
4. Install the timing chain (A).

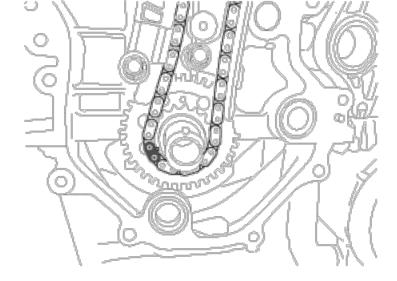
# NOTICE

Install the timing chain with no slack and recommend the below procedure.

Crankshaft sprocket  $\rightarrow$  Timing chain guide  $\rightarrow$  Intake camshaft sprocket (CVVT)  $\rightarrow$  Exhaust camshaft sprocket (CVVT).

The timing mark of each sprocket should be matched with timing mark (color link) of timing chain at during installation.

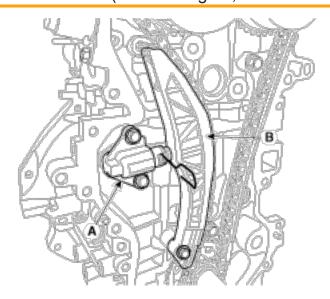




5. Install the timing chain tensioner arm (B) and the timing chain tensioner (A) and then remove the set pin.

#### **Tightening torque:**

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



6. After rotating the crankshaft 2 revolutions in regular direction (clockwise viewed from front), confirm the timing mark.

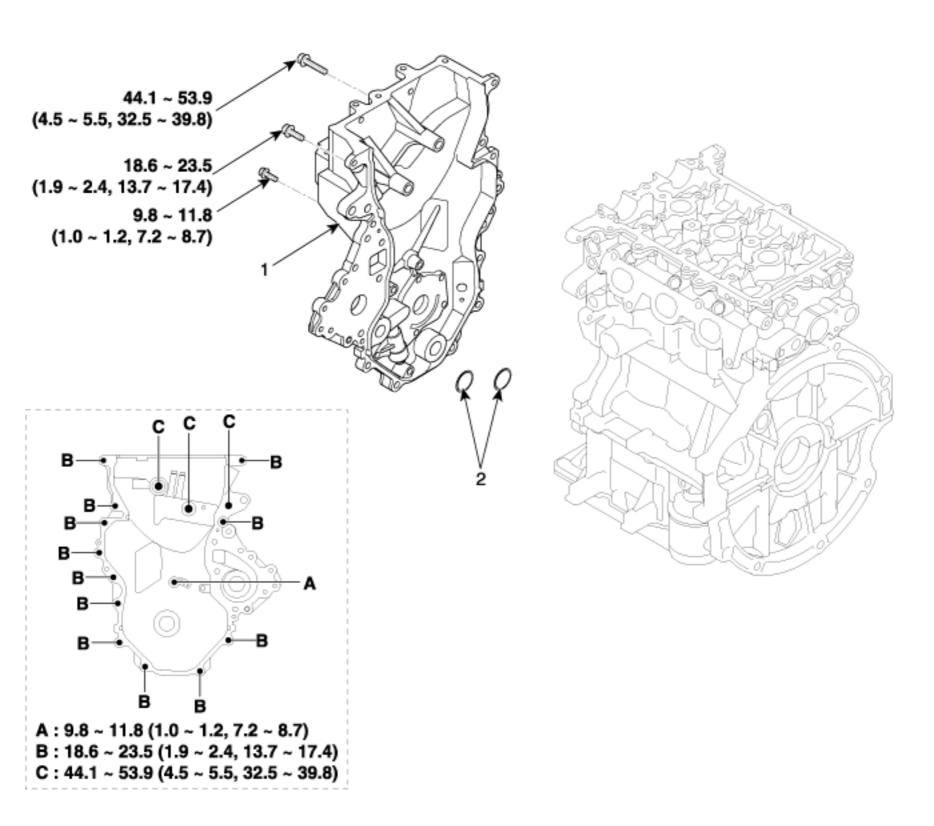
# NOTICE

Always turn the crankshaft clockwise.

Turning the crankshaft counter clockwise before building up oil pressure in the hydraulic timing chain tensioner may result in the chain disengaging from the sprocket teeth.

7. Install the other parts in the reverse order of removal.

### **COMPONENTS**



# Torque : N.m(kgf.m, lb-ft)

1. Timing chain cover	

### **REMOVAL**

Engine removal is not required for this procedure.

## **▲** CAUTION

- · Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

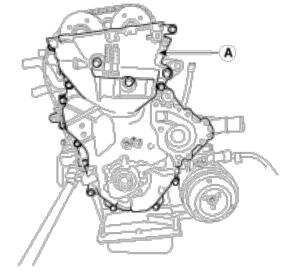
### NOTICE

Mark all wiring and hoses to avoid misconnection.

- Remove the air cleaner assembly.
   (Intake and Exhaust System "Air Cleaner")
- 2. Remove the engine room under cover.
- Remove the drive belt. (Refer to Timing System - "Drive Belt")
- Remove the alternator.
   (Refer to Engine Electrical System "Alternator")
- Remove the crankshaft damper pulley.
   (Refer to Timing System Crankshaft Damper Pulley")
- Remove the water pump.(Refer to Cooling System "Water Pump")
- 7. Remove the cylinder head cover. (Refer to Cylinder Head Assembly "Cylinder Head Cover")
- 8. Remove the engine mounting support bracket.
  (Refer to Engine and Transmission Assembly "Engine Mounting")

#### NOTICE

- Set a jack to support the engine before the mounting bracket is removed.
- Place a rubber block between the jack and oil pan.
- 9. Remove the timing chain cover (A).



### NOTICE

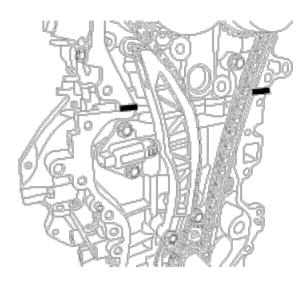
Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover.

### **INSTALLATION**

- 1. Install the timing chain cover (A).
  - (1) The sealant locations on chain cover and on counter parts (cylinder head, cylinder block) must be free of engine oil and etc.
  - (2) Before assembling the timing chain cover, the liquid sealant MS721-40AA should be applied on the gap between cylinder head and cylinder block.

The part must be assembled within 5minutes after sealant was applied.

Bead width: 4.0 mm (0.16 in.)



(3) Before assembling the timing chain cover, The liquid sealant MS721-40AA should be applied on chamfer of timing chain cover. Equivalent to TB1282B or equivalent to TB1216E for groove of water pump. The part must be assembled within 5 minutes after the sealant was applied.

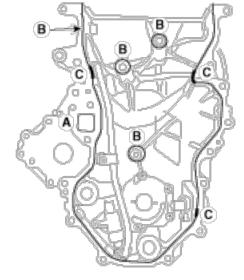
Sealant should be applied in a continuous bead in each of the areas indicated below.

#### **Bead width**

A: 1.5 ~ 2.5 mm (0.06 ~ 0.10 in.)

B:  $2.5 \sim 3.5$  mm  $(0.09 \sim 0.14$  in.)

C:  $3.0 \sim 4.0 \text{ mm} (0.12 \sim 0.16 \text{ in.})$ 



# **NOTICE**

During timing cover installation, care not to take off applied sealant on the timing cover by contact with other parts.

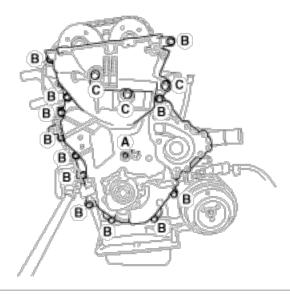
(4) The dowel pins on the cylinder block and holes on the timing chain cover should be used as a reference in order to assemble the timing chain cover correctly.

#### **Tightening torque**

A: 9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft) -1EA

B: 18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft) -12EA

C: 44.1 ~ 53.9 N.m (4.5 ~ 5.5 kgf.m, 32.5 ~ 39.8 lb-ft) -3EA

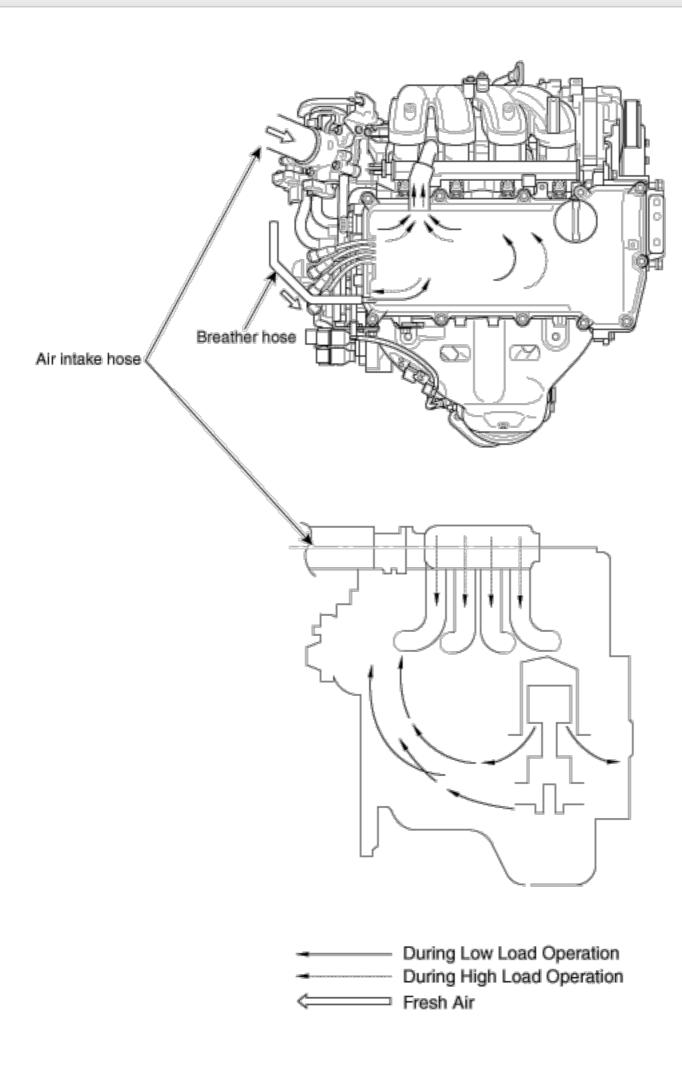


# **▲** CAUTION

The engine starting or pressuer tests should not be performed within 30minutes after the timing chain cover was assembled.

2. Install the other parts in the reverse order of removal.

# **COMPONENTS**

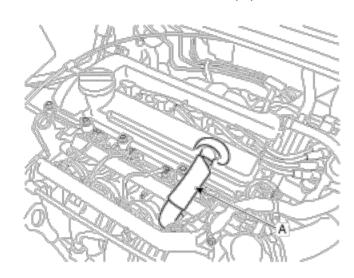


# **OPERATION**

Intake manifold side (No vacuum)		Intake manifold side (High vacuum)	
Rocker cover side		Rocker cover side	
Engine condition	Not running	Engine condition	Idling or decelerating
PCV valve	Not operating	PCV valve	Fully operating
Vacuum passage	Restricted	Vacuum passage Small	
Intake manifold side (Moderate vacuum)		Intake manifold si	de (Low vacuum)
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Rocker cover side			over side
Engine condition	Normal operation	Engine condition Accelerating and high	
PCV valve	Properly operating	PCV valve Slightly operating	
Vacuum passage	Large	Vacuum passage	Very large

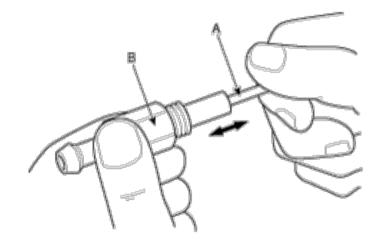
### **REMOVAL**

1. Disconnect the vacuum hose (A) and remove the PCV valve.



### **INSPECTION**

- 1. Remove the PCV valve.
- 2. Insert a thin(A) into the PCV valve(B) from the theaded side to check that the pluger moves.
- 3. If the pluger dose not move, the PCV valve is clogged. Clean it or replace.



### **INSTALLATION**

Install the PCV valve and tighten to the specified torque.

#### **PCV Valve installation:**

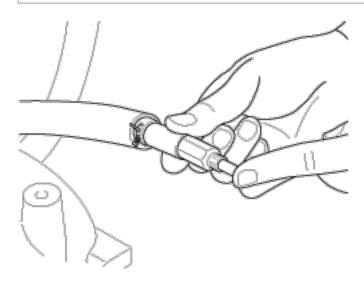
7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.8 ~ 8.7lb-ft)

# **INSPECTION**

- 1. Disconnect the ventilation hose from the positive crankcase ventilation (PCV) valve. Remove the PCV valve from the rocker cover and reconnect it to the ventilation hose.
- 2. Run the engine at idle and put a finger on the open end of the PCV valve and make sure that intake manifold vacuum can be felt.

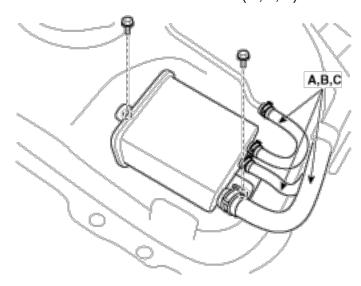
# NOTICE

The plunger inside the PCV valve will move back and forth.



### **REMOVAL**

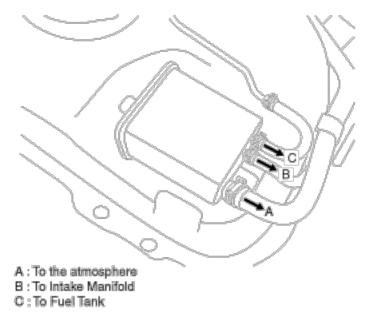
- 1. Remove the fuel tank (Refer to "FUEL TANK" in FL group).
- 2. Disconnect the vacuum hoses (A,B,C).



3. Unscrew 2 bolts and remove the canister assembly from the fuel tank.

### **INSPECTION**

- 1. Look for loose connections, sharp bends or damage to the fuel vapor lines.
- 2. Look for distortion, cracks or fuel damage.
- 3. After removing the canister, inspect for cracks, damage or saturated canister.



### **INSTALLATION**

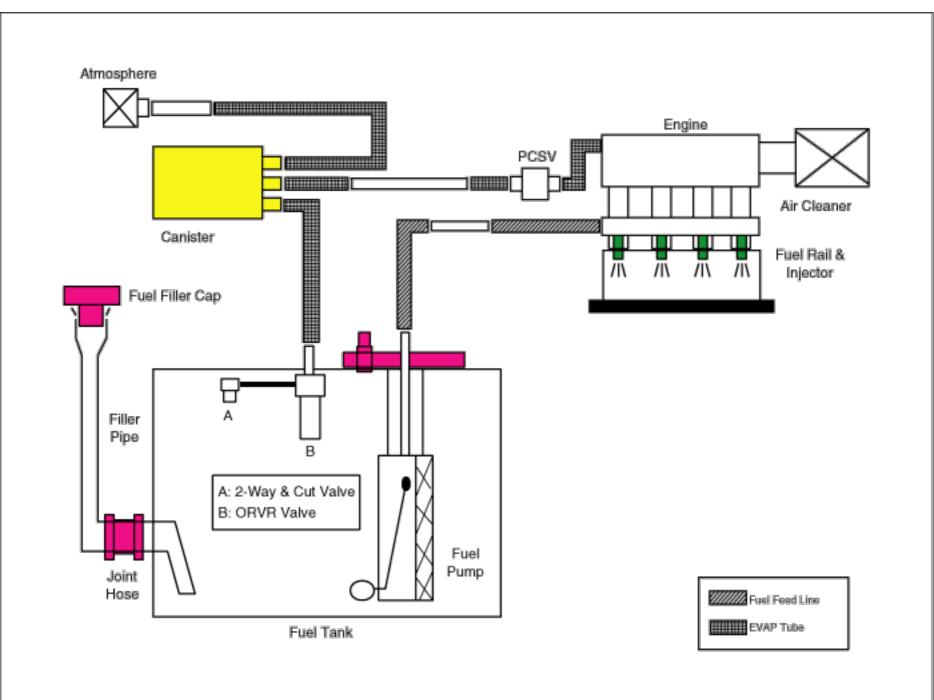
Install the canister according to the reverse order of "REMOVAL" procedure.

#### **DESCRIPTION**

Evaporative Emission Control System prevents fuel vapor stored in fuel tank from vaporizing into the atmosphere.

When the fuel evaporates in the fuel tank, the vapor passes through vent hoses or tubes to the canister filled with charcoal and the canister temporarily holds the vapor in the charcoal.

If ECM determines to draw the gathered vapor into the combustion chambers during certain operating conditions, it will use vacuum in intake manifold to move it.



#### Canister

Canister is filled with charcoal and absorbs evaporated vapor in fuel tank. The gathered fuel vapor in canister is drawn into the intake manifold by the ECM/PCM when appropriate conditions are set.

### Purge Control Solenoid Valve (PCSV)

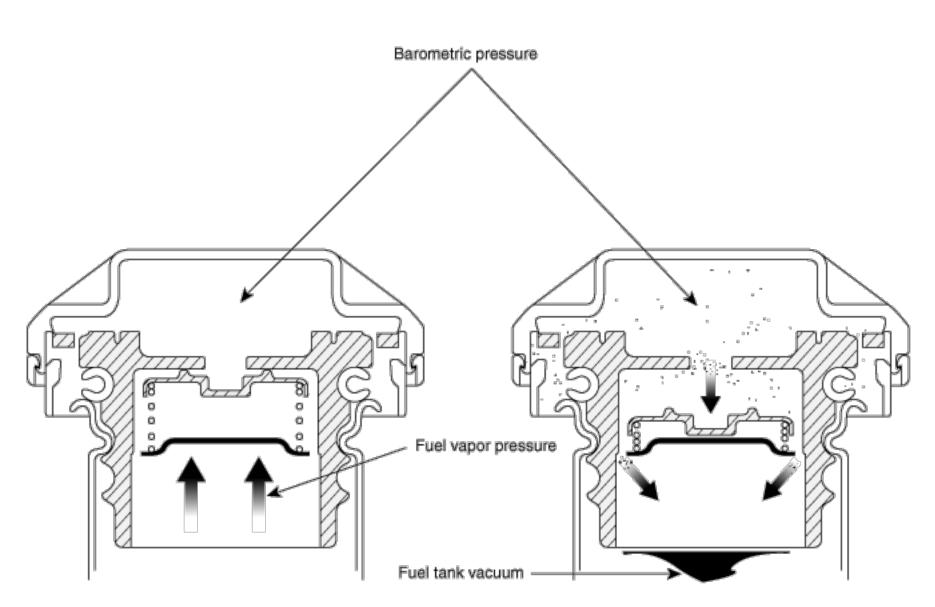
Purge Control Solenoid Valve (PCSV) is installed in the passage connecting canister and intake manifold. It is a duty type solenoid valve and is operated by ECM/PCM signal. To draw the absorbed vapor into the intake manifold, the ECM/PCM will open the PCSV, otherwise the passage remains closed.

#### **Fuel Filler Cap**

A ratchet tightening device on the threaded fuel filler cap reduces the chances of incorrect installation, which would seal the fuel filler. After the gasket on the fuel filler cap and the fill neck flange contact each other, the ratchet produces a loud clicking noise indicating the seal has been set.

### **DESCRIPTION**

A ratchet tightening device on the threaded fuel filler cap reduces the chances of incorrect installation, which would seal the fuel filler. After the gasket on the fuel filler cap and the filler neck flange contact each other, the ratchet produces a loud clicking noise indicating the seal has been set.



When fuel tank is under pressure.

When fuel tank is under vacuum.

#### **INSPECTION**

### [EVAPORATIVE EMISSION CONTROL SYSTEM]

- 1. Disconnect the vacuum hose from the throttle body, and connect a vacuum pump to the vacuum hose.
- 2. Check the following points when the engine is cold [engine coolant temperature 60°C(140°F) or below] and when it is warm [engine coolant temperature 80°C(176°F) or higher].

### When Engine Is Cold

Engine operating condition	Applied vacuum	Result
Idling	50 kPa (7.3 psi)	Vacuum is held
3,000 rpm		

### When Engine Is Warm

Engine operating condition	Applied vacuum	Result
Idling	50 kPa (7.3 psi)	Vacuum is held
Within 3 minutes after engine start at 3,000 rpm	Try to apply vacuum	Vacuum is released
After 3 minutes have passed after engine start at 3,000 rpm	50 kPa (7.3 psi)	Vacuum will be held momentarily, after which, it will be released

# [PURGE CONTROL SOLENOID VALVE (PCSV)]

# NOTICE

When disconnecting the vacuum hose, make an identification mark on it so that it can be reconnected to its original position.

- 1. Disconnect the vacuum hose from the solenoid valve.
- 2. Detach the harness connector.
- 3. Connect a vacuum pump to the nipple which is connected to intake manifold.
- 4. Apply vacuum and check when voltage is applied to the PCSV and when the voltage is discontinued.

Battery voltage	Normal condition
When applied	Vacuum is released
When discontinued	Vacuum is maintained

5. Measure the resistance between the terminals of the solenoid valve.

**PCSV** coil resistance( $\Omega$ ): 16 [20°C (68°F)]

### **DESCRIPTION**

Exhaust emissions (CO, HC, NOx) are controlled by a combination of engine modifications and the addition of special control components.

Modifications to the combustion chamber, intake manifold, camshaft and ignition system form the basic control system. These items have been integrated into a highly effective system which controls exhaust emissions while maintaining good driveability and fuel economy.

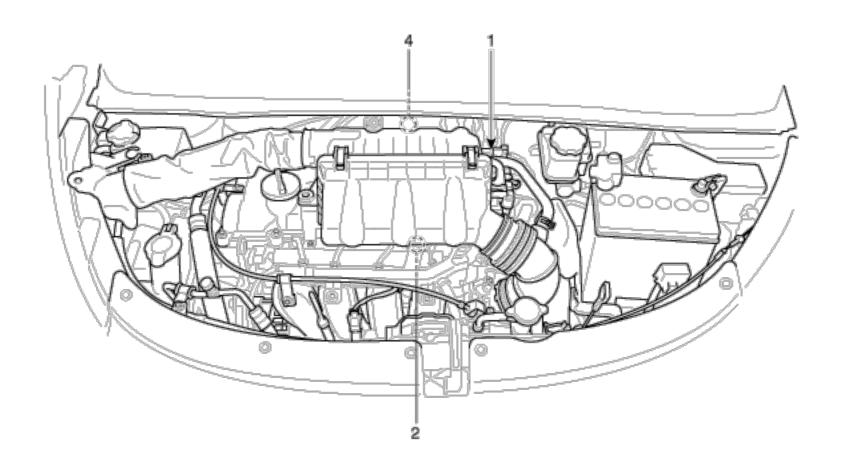
### Air/fuel Mixture Control System [Multiport Fuel Injection (MFI) System]

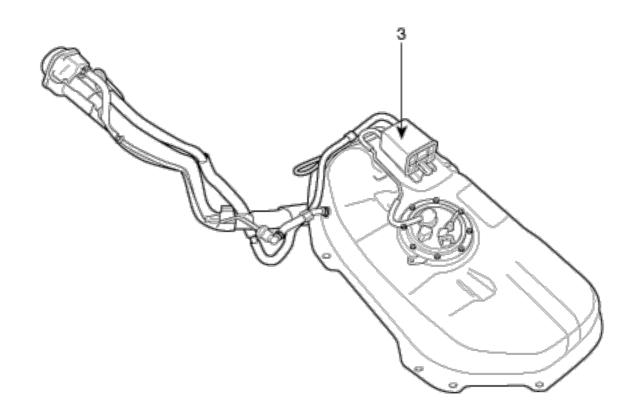
The MFI system is a system which uses the signals from the heated oxygen sensor to activate and control the injector installed in the manifold for each cylinder, thus precisely regulating the air/fuel mixture ratio and reducing emissions.

This in turn allows the engine to produce exhaust gases of the proper composition to permit the use of a three way catalyst. The three way catalyst is designed to convert the three pollutants (1) hydrocarbons (HC), (2) carbon monoxide (CO), and (3) oxides of nitrogen (NOx) into harmless substances. There are two operating modes in the MFI system.

- 1. Open Loop air/fuel ratio is controlled by information programmed into the ECM.
- 2. Closed Loop air/fuel ratio is adjusted by the ECM based on information supplied by the oxygen sensor.

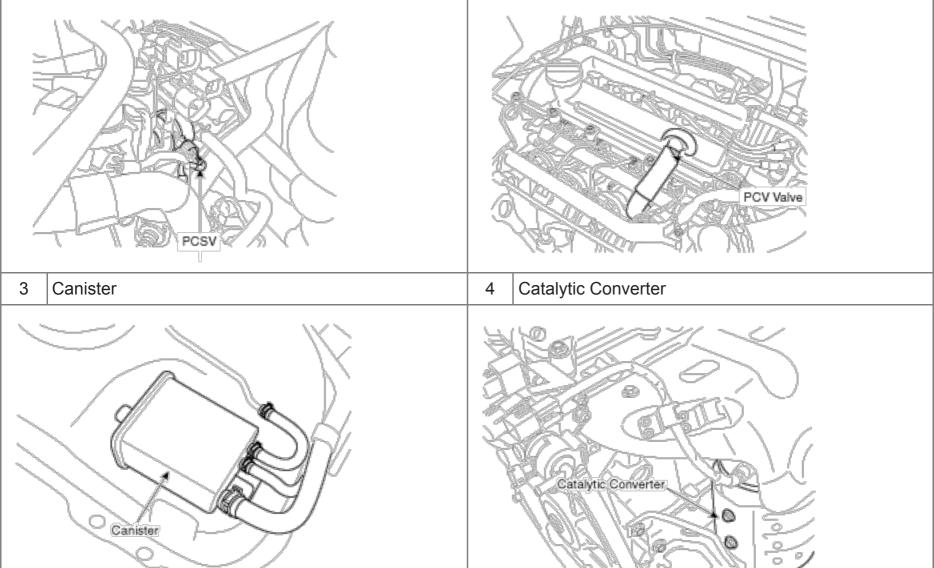
# **COMPONENT LOCATION**





- 1. Purge Control Solenoid Valve (PCSV)
- 2. PCV Vlave

- 3. Canister
- 4. Catalytic Converter
- 1 Purge Control Solenoid Valve (PCSV)

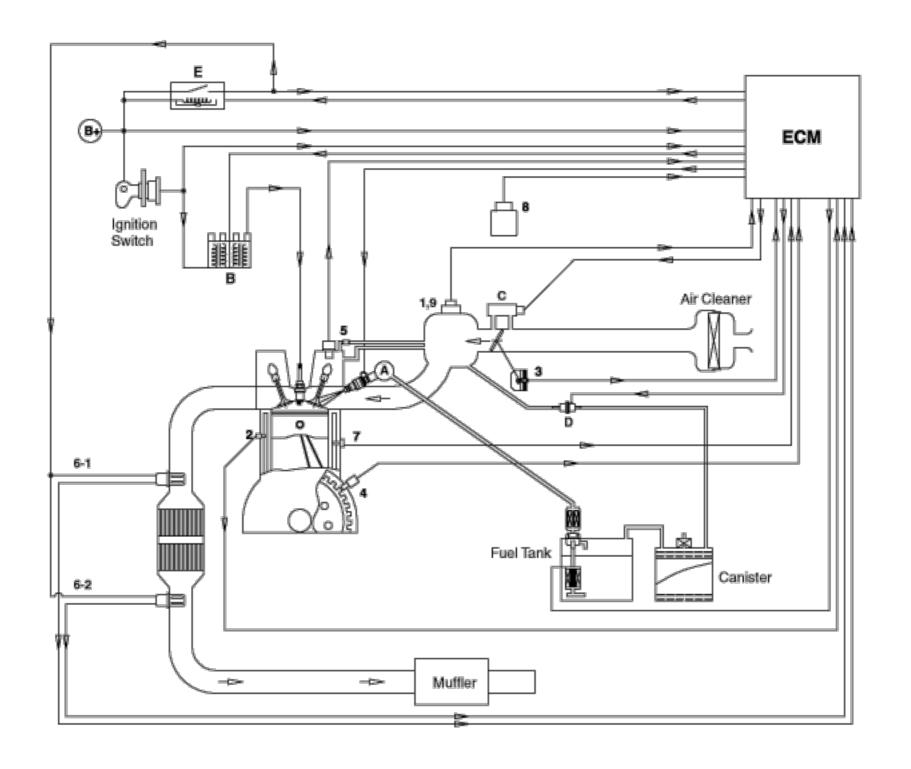


# **DESCRIPTION**

Components	Function	Remarks
Crankcase Emission System  – Positive Crankcase Ventilation (PCV) valve	HC reduction	Variable flow rate type
Evaporative Emission System  - Evaporative emission canister  - Purge Control Solenoid Valve (PCSV)	HC reduction HC reduction	Duty control solenoid valve
Exhaust Emission System  – MFI system (air-fuel mixture control device)	CO, HC, NOx reduction CO, HC, NOx reduction	Heated oxygen sensor feedback type Monolithic type
<ul> <li>Three-way catalytic converter</li> </ul>		

### **SCHEMATIC DIAGRAM**

1. Manifold Absolute Pressure Sensor (MAPS) 2. Engine Coolant Temperature Sensor (ECTS) 3. Throttle Position Sensor (TPS) A. Injector 4. Crankshaft Position Sensor (CKPS) B. Ignition Coll 5. Camshaft Position Sensor (CMPS) C. Idle Speed Control Actuator (ISCA) INPUT OUTPUT 6-1. Heated Oxygen Sensor (HO2S, Sensor 1) D. Purge Control Solenoid Valve (PCSV) 6-2. Heated Oxygen Sensor (HO2S, Sensor 2) ECM E. Main Relay 7. Knock Sensor F. Fuel Pump Relay 8. Vehicle Speed Sensor (VSS) 9. Intake Air Temperature Sensor (IATS) · Switch Input Signals



# **SPECIFICATIONS**

# Purge Control Solenoid Valve (PCSV)

Item	Specification
Coil Resistance (Ω)	16 [20°C (68°F)]

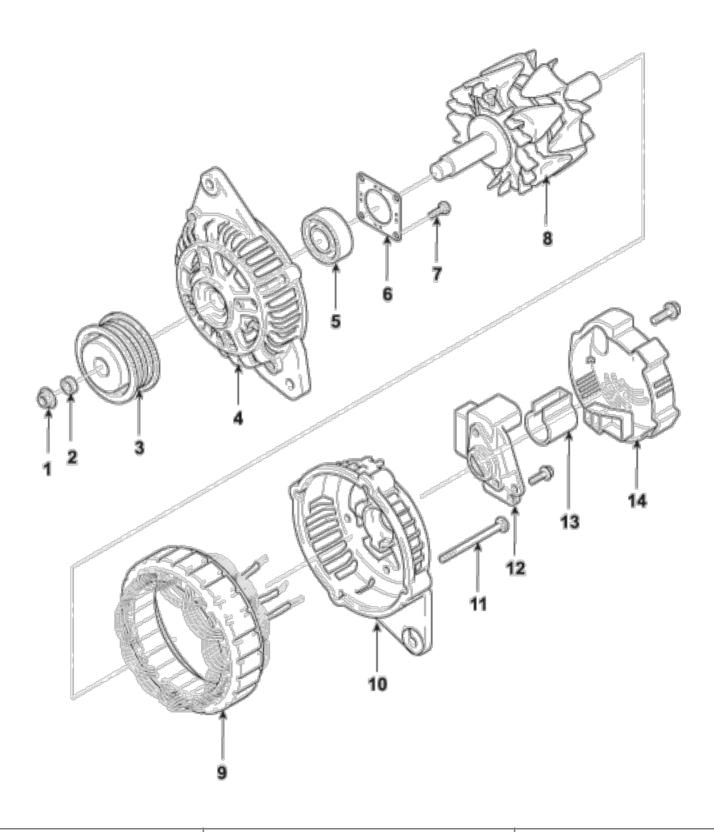
# **TIGHTENING TORQUES**

Item	N.m	kgf.m	lb-ft
Positive Crankcase Ventilation Valve	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7

# **TROUBLESHOOTING**

Symptom	Suspect area	Remedy
Engine will not start or hard to	Vacuum hose disconnected or damaged	Repair or replace
start	Malfunction of the Purge Control Solenoid Valve	Repair or replace
	Vacuum hose disconnected or damaged	Repair or replace
	Malfunction of the PCV valve	Replace
Rough idle or engine stalls	Malfunction of the evaporative emission canister purge system	Check the system; if there is a problem, check related components parts
Excessive oil consumption	Positive crankcase ventilation line clogged	Check positive crankcase ventilation system

# **COMPONENT**



- 1. Nut
- 2. Spacer
- 3. Pulley
- 4. Front bracket
- 5. Front bearing

- 6. Bearing cover
- 7. Bearing cover bolt
- 8. Rotor
- 9. Stator
- 10. Rear bracket

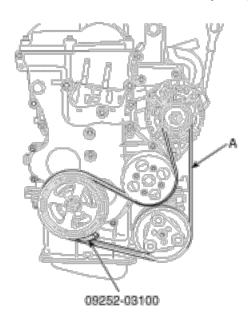
- 11. Through bolts
- 12. Regulator
- 13. Slip ring guide
- 14. Rear cover

# **REPLACEMENT**

- 1. Disconnect the battery negative terminal first, then the positive terminal.
- 2. Remove the drive belt (A).

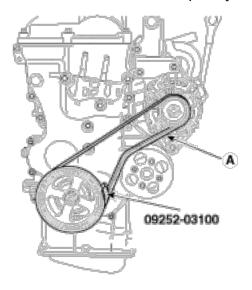
### [Full-option type]

- (1) Insert the SST(09252-03100) between the crankshaft pulley and the drive belt.
- (2) Rotate 2 revolutions of crankshaft pulley into clockwise direction. And then remove the drive belt.

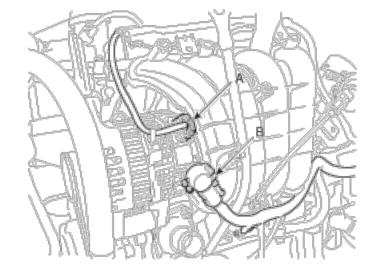


# [Non- A/C type]

- (3) Insert the SST(09252-03100) between the crankshaft pulley and the drive belt.
- (4) Rotate 2 revolutions of crankshaft pulley into clockwise direction. And then remove the drive belt.



3. Disconnect the alternator connector (A), and remove the cable (B) from the alternator "B" terminal.



4. Remove the alternator (A).

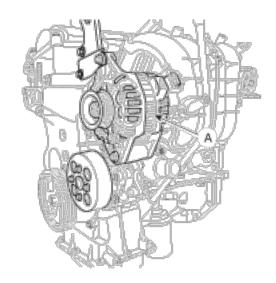
#### **Tightening torque**

Lower bolt:

29.4 ~ 41.2 N.m (3.0 ~ 4.2 kgf.m, 21.7 ~ 30.4 lb-ft)

Upper bolt:

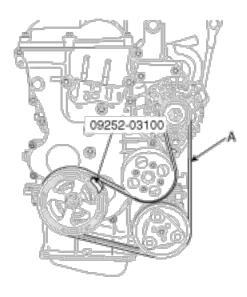
19.6 ~ 26.5 N.m (2.0 ~ 2.7 kgf.m, 14.5 ~ 19.5 lb-ft)



- 5. Installation is reverse order of removal.
- 6. Install the drive belt (A).

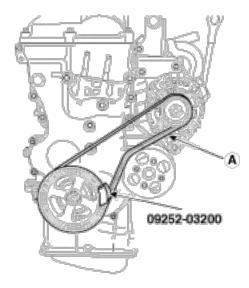
# [Full-option type]

- (1) Pre-position the drive belt on the water pump, alternator, A/C compressor pulleys. Make sure the belt is properly fitted on groove pulleys of alternator and A/C compressor.
- (2) Insert the SST(09252-03100) between the crankshaft pulley and the drive belt.
- (3) Rotate 2 revolutions of crankshaft pulley into counterclockwise direction.
- (4) Remove the tool and make sure the belt is properly installed.



# [Non-A/C type]

- (5) Pre-position the drive belt on the water pump, alternator pulleys. Make sure the belt is properly fitted on groove pulley of alternator.
- (6) Insert the SST(09252-03200) between the crankshaft pulley and the drive belt.
- (7) Rotate 2 revolutions of crankshaft pulley into clockwise direction.
- (8) Remove the tool and make sure the belt is properly installed.

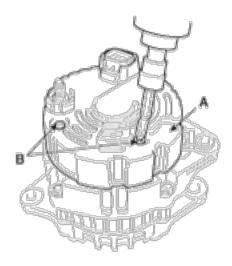


# NOTICE

The belt must be free from any harmful damage during installation.

### **DISASSEMBLY**

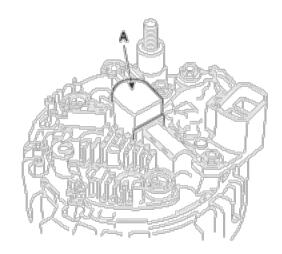
1. Remove the 2 bolts (B) and rear cover (A).



2. Remove the slip ring guide (A) from the regulator.

# NOTICE

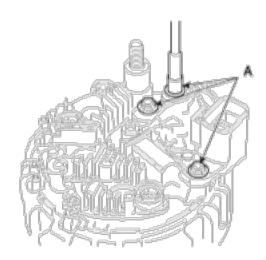
When removing the slip ring guide, be careful that other parts are not damaged.



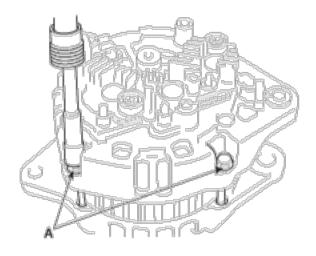
3. Remove the 3 bolts (A) and regulator.

# NOTICE

When removing the regulator, be careful that slip ring is not damaged.



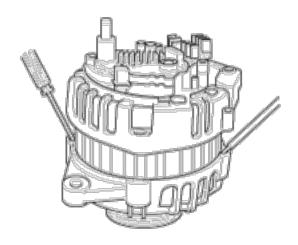
4. Remove the 4 through bolts (A).



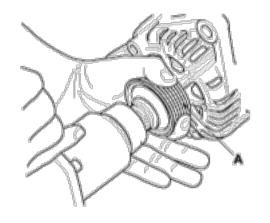
5. Insert a flat screwdriver between the front bracket and stator core, and pry downward.



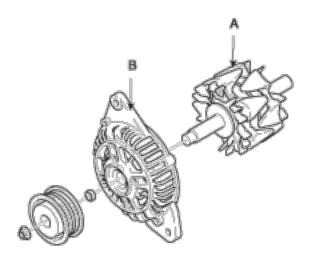
Do not insert the screwdriver too deeply, as there is a danger of damaging the stator coil.



6. Remove the nut and pulley (A).



7. Remove the rotor (A) and front bracket (B).

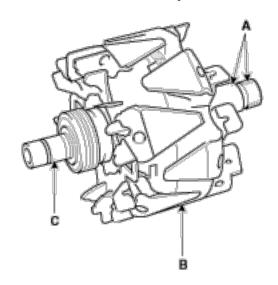


8. Reassembly is the reverse order of disassembly.

#### **INSPECTION**

## **Inspect Rotor**

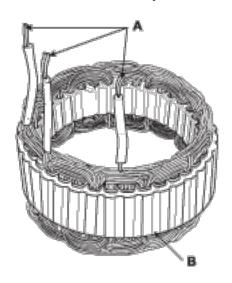
1. Check that there is continuity between the slip rings (C).



- 2. Check that there is no continuity between the slip rings and the rotor (B) or rotor shaft (A).
- 3. If the rotor fails either continuity check, replace the alternator.

# **Inspect Stator**

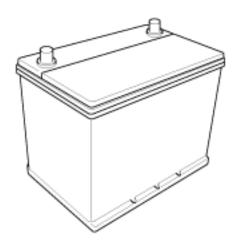
1. Check that there is continuity between each pair of leads (A).



- 2. Check that there is no continuity between each lead and the coil core.
- 3. If the coil fails either continuity check, replace the alternator.

# **DESCRIPTION**

- 1. The maintenance-free battery is, as the name implies, totally maintenance free and has no removable battery cell caps.
- 2. Water never needs to be added to the maintenance-free battery.
- 3. The battery is completely sealed, except for small vent holes in the cover.

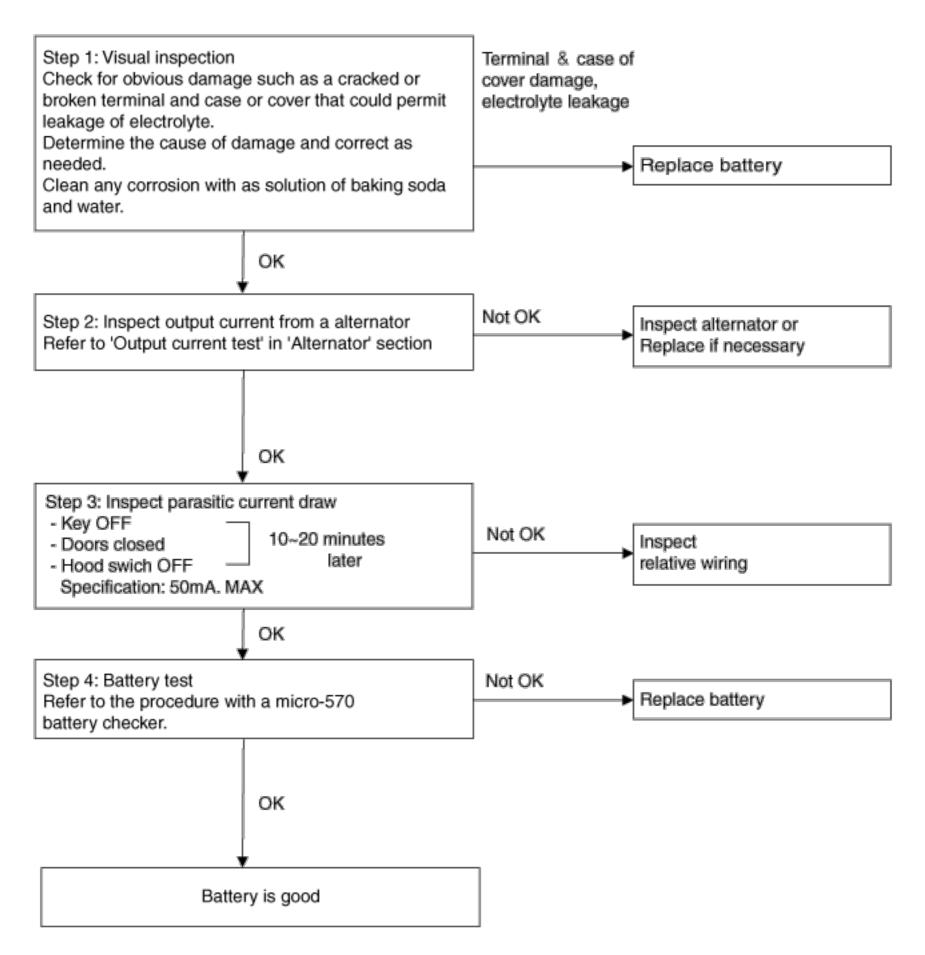


# NOTICE

After disconnecting then reconnecting the battery negative cable, reset some parts that require the reset procedures. (Refer to BE group – General Information)

#### **INSPECTION**

## **Battery Diagnostic Flow**



## Vehicle parasitic current inspection

- 1. Turn the all electric devices OFF, and then turn the ignition switch OFF.
- 2. Close all doors except the engine hood, and then lock all doors.

- (1) Disconnect the hood switch connector.
- (2) Close the trunk lid.
- (3) Close the doors or remove the door switches.
- 3. Wait a few minutes until the vehicle's electrical systems go to sleep mode.

#### **NOTICE**

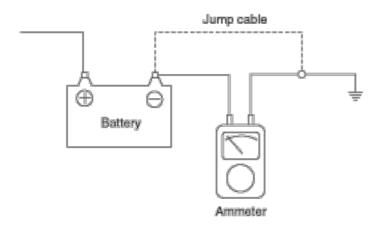
For an accurate measurement of a vehicle parasitic current, all electriacl systems should go to sleep mode. (It takes at least one hour or at most one day.) However, an approximate vehicle parasitic current can be measured after 10~20 minutes.

4. Connect an ammeter in series between the battery (-) terminal and the ground cable, and then disconnect the clamp from the battery (-) terminal slowly.

## **▲** CAUTION

Be careful that the lead wires of an ammeter do not come off from the battery (-) terminal and the ground cable to prevent the battery from being reset. In case the battery is reset, connect the battery cable again, and then start the engine or turn the ignition switch ON for more than 10 sec. Repeat the procedure from No. 1. To prevent the battery from being reset during the inspection,

- a. Connect a jump cable between the battery (-) terminal and the ground cable.
- b. Disconnect the ground cable from the battery (-) terminal.
- c. Connect an ammeter between the battery (-) terminal and the ground cable.
- d. After disconnecting the jump cable, read the current value of the ammeter.



- 5. Read the current value of the ammeter.
  - If the parasitic current is over the limit value, search for abnormal circuit by removing a fuse one by one and checking the parasitic current.
  - Check the parasitic current again, and search for suspected unit by removing a unit connected with the abnormal circuit one by one.

Limit value (after 10~20 min.): Below 50mA

#### **CLEANING**

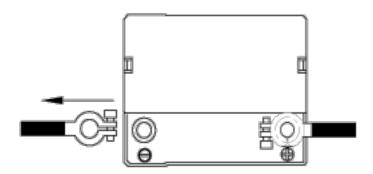
- 1. Make sure the ignition switch and all accessories are in the OFF position.
- 2. Disconnect the battery cables (negative first).

3. Remove the battery from the vehicle.

## **▲** CAUTION

Care should be taken in the event the battery case is cracked or leaking, to protect your skin from the electrolyte.

Heavy rubber gloves (not the household type) should be wore when removing the battery.

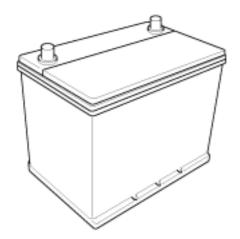


- 4. Inspect the battery tray for damage caused by the loss of electrolyte. If acid damage is present, it will be necessary to clean the area with a solution of clean warm water and baking soda. Scrub the area with a stiff brush and wipe off with a cloth moistened with baking soda and water.
- 5. Clean the top of the battery with the same solution as described above.
- 6. Inspect the battery case and cover for cracks. If cracks are present, the battery must be replaced.
- 7. Clean the battery posts with a suitable battery post tool.
- 8. Clean the inside surface of the terminal clamps with a suitable battery cleaning tool. Replace damaged or frayed cables and broken terminal clamps.
- 9. Install the battery in the vehicle.
- 10. Connect the cable terminals to the battery post, making sure tops of the terminals are flush with the tops of the posts.
- 11. Tighten the terminal nuts securely.
- 12. Coat all connections with light mineral grease after tightening.

## **▲** CAUTION

When batteries are being charged, an explosive gas forms beneath the cover of each cell. Do not smoke near batteries being charged or which have recently been charged. Do not break live circuit at the terminals of batteries being charged.

A spark will occur when the circuit is broken. Keep open flames away from battery.



## **DESCRIPTION**

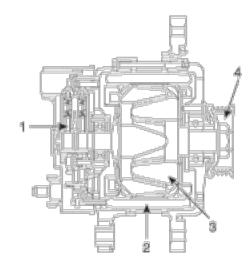
The charging system consists a battery, an alternator with a built-in regulator, and the charging indicator light and wire.

The Alternator has built-in diodes, each rectifying AC current to DC current.

Therefore, DC current is present at the alternator "B" terminal.

Additionally, the alternator and charging voltage is regulated by the battery voltage detection system.

The alternators is regulated by the battery voltage detection system. The main components of the alternator are the rotor, stator, rectifier, capacitor, brushes, bearings and V-ribbed belt pulley. The brush holder contains a built-in electronic voltage regulator.



- 1. Brush
- 2. Stator
- 3. Rotor
- 4. Drive belt pulley

#### **ON-VEHICLE INSPECTION**

# **▲** CAUTION

- Check that the battery cables are connected to the correct terminals.
- Disconnect the battery cables when the battery is given a quick charge.
- Never disconnect the battery while the engine is running.

# **Check Battery Voltage**

- 1. If 20 minutes have not passed since the engine was stopped, turn the ignition switch ON and turn on the electrical system (headlamp, blower motor, rear defogger etc.) for 60 seconds to remove the surface charge.
- 2. Turn the ignition switch OFF and turn off the electrical systems.
- 3. Measure the battery voltage between the negative (-) and positive (+) terminals of the battery.

Standard voltage: 12.5 ~ 12.9V at 20°C(68°F)

If the voltage is less than specification, charge the battery.

# **Check The Battery Terminals And Fuses**

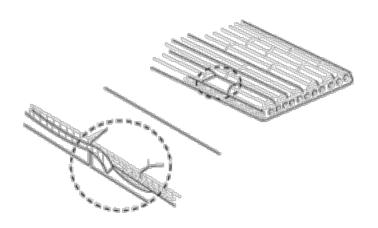
- 1. Check that the battery terminals are not loose or corroded.
- 2. Check the fuses for continuity.

#### **Inspect Drive Belt**

1. Visually check the belt for excessive wear, frayed cords etc. If any defect has been found, replace the drive belt.

## NOTICE

Cracks on the rib side of a belt are considered acceptable. If the belt has chunks missing from the ribs, it should be replaced.



2. Measure the drive belt tension and adjust it.

# Visually Check Alternator Wiring And Listen For Abnormal Noises

- 1. Check that the wiring is in good condition.
- 2. Check that there is no abnormal noise from the alternator while the engine is running.

# Check Discharge Warning Light Circuit

- 1. Warm up the engine, and then turn it off.
- 2. Turn off all accessories.
- 3. Turn the ignition switch "ON". Check that the discharge warning light is lit.
- Start the engine. Check that the light is lit.
   If the light does not go off as specified, troubleshoot the discharge light circuit.

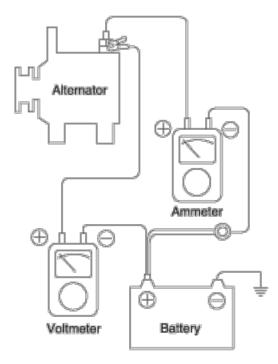
## **Inspect Charging System**

#### Voltage Drop Test Of Alternator Output Wire

This test determines whether or not the wiring between the alternator "B" terminal and the battery (+) terminal is good by the voltage drop method.

### Preparation

- 1. Turn the ignition switch to "OFF".
- 2. Disconnect the output wire from the alternator "B" terminal. Connect the (+) lead wire of ammeter to the "B" terminal of alternator and the (-) lead wire of ammeter to the output wire. Connect the (+) lead wire of voltmeter to the "B" terminal of alternator and the (-) lead wire of voltmeter to the (+) terminal of battery.



#### Test

- 1. Start the engine.
- 2. Turn on the headlamps and blower motor, and set the engine speed until the ammeter indicates 20A. And then, read the voltmeter at this time.

#### Result

1. The voltmeter may indicate the standard value.

Standard value: 0.2V max

- 2. If the value of the voltmeter is higher than expected (above 0.2V max.), poor wiring is suspected. In this case check the wiring from the alternator "B" terminal to the battery (+) terminal. Check for loose connections, color change due to an over-heated harness, etc. Correct them before testing again.
- 3. Upon completion of the test, set the engine speed at idle. Turn off the headlamps, blower motor and the ignition switch.

## **Output Current Test**

This test determines whether or not the alternator gives an output current that is equivalent to the normal output.

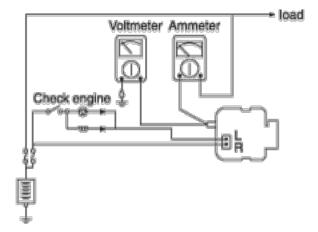
## **Preparation**

- 1. Prior to the test, check the following items and correct as necessary.
  - Check the battery installed in the vehicle to ensure that it is good condition. The battery checking method is described in the section "Battery".
  - The battery that is used to test the output current should be one that has been partially discharged. With a fully charged battery, the test may not be conducted correctly due to an insufficient load.
  - Check the tension of the alternator drive belt. The belt tension check method is described in the section "Inspect drive belt".
- 2. Turn off the ignition switch.
- 3. Disconnect the battery ground cable.
- 4. Disconnect the alternator output wire from the alternator "B" terminal.
- 5. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire. Be sure to connect the (-) lead wire of the ammeter to the disconnected output wire.

## NOTICE

Tighten each connection securely, as a heavy current will flow. Do not rely on clips.

- 6. Connect a voltmeter (0 to 20V) between the "B" terminal and ground. Connect the (+) lead wire to the alternator "B" terminal and (-) lead wire to a good ground.
- 7. Attach an engine tachometer and connect the battery ground cable.
- 8. Leave the engine hood open.



#### Test

- 1. Check to see that the voltmeter reads as the same value as the battery voltage. If the voltmeter reads 0V, and the open circuit in the wire between alternator "B" terminal and battery (+) terminal or poor grounding is suspected.
- 2. Start the engine and turn on the headlamps.
- 3. Set the headlamps to high beam and the heater blower switch to HIGH, quickly increase the engine speed to 2,500 rpm and read the maximum output current value indicated by the ammeter.

#### NOTICE

After the engine start up, the charging current quickly drops. Therefore, the above operation must be done quickly to read the maximum current value correctly.

#### Result

1. The ammeter reading must be higher than the limit value. If it is lower but the alternator output wire is in good condition, remove the alternator from the vehicle and test it.

Limit value (70A alternator): 49A min.

#### **NOTICE**

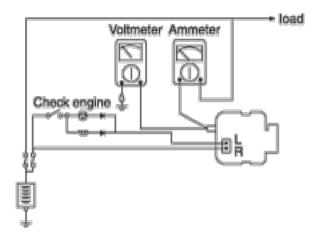
- The nominal output current value is shown on the nameplate affixed to the alternator body.
- The output current value changes with the electrical load and the temperature of the alternator itself.
   Therefore, the nominal output current may not be obtained. If such is the case, keep the headlamps on the cause discharge of the battery, or use the lights of another vehicle to increase the electrical load.
   The nominal output current may not be obtained if the temperature of the alternator itself or ambient temperature is too high.
  - In such a case, reduce the temperature before testing again.
- 2. Upon completion of the output current test, lower the engine speed to idle and turn off the ignition switch.
- 3. Disconnect the battery ground cable.
- 4. Remove the ammeter and voltmeter and the engine tachometer.
- 5. Connect the alternator output wire to the alternator "B" terminal.
- 6. Connect the battery ground cable.

## Regulated Voltage Test

The purpose of this test is to check that the electronic voltage regulator controls voltage correctly.

## **Preparation**

- Prior to the test, check the following items and correct if necessary.
   Check that the battery installed on the vehicle is fully charged. The battery checking method is described in the section "Battery".
  - Check the alternator drive belt tension. The belt tension check method is described in the section "Inspect drive belt".
- 2. Turn ignition switch to "OFF".
- 3. Disconnect the battery ground cable.
- 4. Connect a digital voltmeter between the "B" terminal of the alternator and ground. Connect the (+) lead of the voltmeter to the "B" terminal of the alternator. Connect the (-) lead to good ground or the battery (-) terminal.
- 5. Disconnect the alternator output wire from the alternator "B" terminal.
- 6. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire. Connect the (-) lead wire of the ammeter to the disconnected output wire.
- 7. Attach the engine tachometer and connect the battery ground cable.



#### Test

1. Turn on the ignition switch and check to see that the voltmeter indicates the following value.

Voltage: Battery voltage

If it reads 0V, there is an open circuit in the wire between the alternator "B" terminal and the battery and the battery (-) terminal.

- 2. Start the engine. Keep all lights and accessories off.
- 3. Run the engine at a speed of about 2,500 rpm and read the voltmeter when the alternator output current drops to 10A or less.

#### Result

1. If the voltmeter reading agrees with the value listed in the regulating voltage table below, the voltage regulator is functioning correctly. If the reading is other than the standard value, the voltage regulator or the alternator is faulty.

#### **Regulating Voltage Table**

Voltage regulator ambient temperature °C (°F)	Regulating voltage (V)		
-20 (-4)	14.2 ~ 15.4		
20 (68)	14.0 ~ 15.0		
60 (140)	13.7 ~ 14.9		
80 (176)	13.5 ~ 14.7		

- 2. Upon completion of the test, reduce the engine speed to idle, and turn off the ignition switch.
- 3. Disconnect the battery ground cable.
- 4. Remove the voltmeter and ammeter and the engine tachometer.
- 5. Connect the alternator output wire to the alternator "B" terminal.
- 6. Connect the battery ground cable.

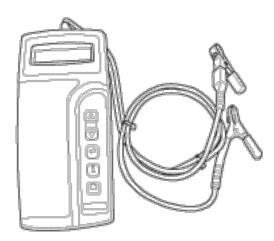
#### **THE MICRO 570 ANALYZER**

The Micro 570 Analyzer provides the ability to test the charging and starting systems, including the battery, starter and alternator.

# **▲** CAUTION

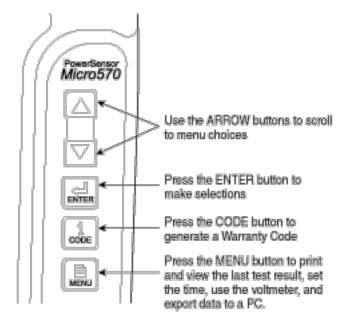
- \* Because of the possibility of personal injury, always use extreme caution and appropriate eye protection when working with batteries.
- \* When charging battery by test result, Battery must be fully charged.

To get accurate test result, battery surface voltage must have subsided ahead before test when you test battery after charged. (See following Battery Test Results)



## Keypad

The Micro 570 button on the key pad provide the following functions:



## **Battery Test Procedure**

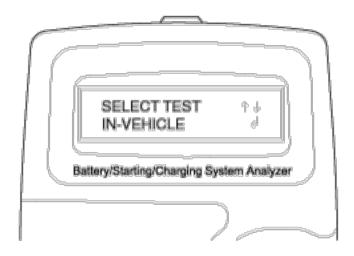
- 1. Connect the tester to the battery.
  - Red clamp to battery positive (+) terminal.
  - Black clamp to battery negative (-) terminal.



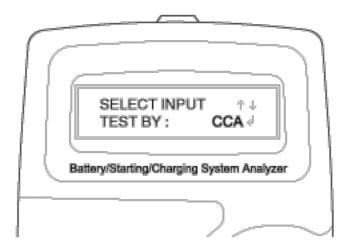
# **▲** CAUTION

Connect clamps securely. If "CHECK CONNECTION" message is displayed on the screen, reconnect clamps securely.

2. The tester will ask if the battery is connected "IN-VEHICLE" or "OUT-OF-VEHICLE". Make your selection by pressing the arrow buttons; then press ENTER.



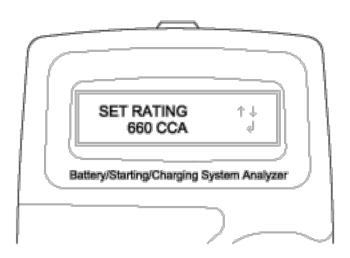
3. Select CCA and press the ENTER button.



#### NOTICE

CCA: Cold cranking amps, is an SAE specification for cranking batteried at -0.4°F (-18°C).

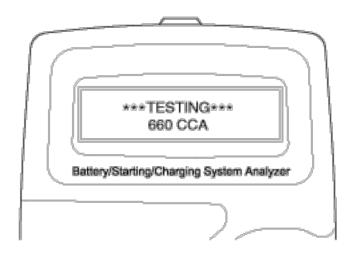
4. Set the CCA value displayed on the screen to the CCA value marked on the battery label by pressing up and down buttons and press ENTER.



# NOTICE

The battery ratings(CCA) displayed on the tester must be identical to the ratings marked on battery label.

5. The tester will conduct battery test.



6. The tester displays battery test results including voltage and battery ratings.

Refer to the following table and take the appropriate action as recommended by the Micro 570.



# **Battery Test Results**

Result On Printer	Remedy
GOOD BATTERY	No action is required.
GOOD RECHARGE	Battery is in a good state. Recharge the battery and use.  *You have to follow instruction below when you charge battery and retest, otherwise test result can be inaccurate. (See 'Charge and Retest method after battery charge' below.)
CHARGE & RETEST	Battery is not charged properly.

	Charge and test the battery again.
	* You have to follow instruction below when you charge battery and retest, otherwise test result can be inaccurate. (See 'Charge and Retest method after battery charge' below.)
REPLACE BATTERY	Replace battery and recheck the charging system.
	<ul> <li>Improper connection between battery and vehicle cables may cause "REPLACE BATTERY". Retest the battery after removing cables and connecting the tester to the battery terminal directly prior to replacing the battery.</li> </ul>
BAD CELL-REPLACE	Charge and retest the battery.
	<ul> <li>If the Micro 570 recommends "REPLACE BATTERY", replace the battery and recheck the charging system.</li> </ul>

## [Charge and Retest method after battery charge]

#### **Battery charge**

Set battery charger to 'Auto Mode' (The Mode that charging current drops as the battery charges.) and charge battery until charging current down close to zero or the charger alerts you with an alarm when charge is complete. (Minimum charging time recommended: More than 3 hours with Auto Mode that explained above)

- If battery is not fully charged, battery surface voltage will be high while the amount of current charged (CCA) in battery is low. If you measure the battery under this condition, tester may misjudge that battery sulfation occurred because the amount of current in battery is too low in comparison with battery voltage.
  - \* Surface voltage: When battery is charged electrolyte temperature increases and chemical reaction become active resulting in an excessive increase of battery voltage.

It is known that it takes approximate one day to subside this increased surface voltage completely.

#### **Battery Test after charge**

Do not test battery right after the charge. Test battery after battery surface voltage has subsided as instructed in the following procedure.

- (1) When battery charge is complete, install the battery in the vehicle.
- (2) Put IG key to ON position and turn on head lamp with low beam, and wait 5 minutes. (Discharge for 5 minutes)
- (3) Turn off the head lamp and IG key, and wait 5 minutes. (Waiting for 5 minutes)
- (4) Remove +, cable from the battery and test battery.

# **AWARNING**

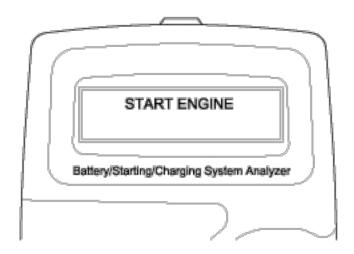
Whenever filing a claim for battery, the print out of the battery test results must be attached.

#### **Starter Test Procedure**

7. After the battery test, press ENTER immediately for the starter test.

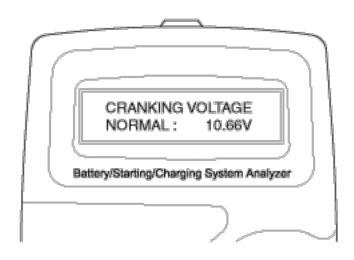


8. Start the engine.



9. Cranking voltage and starter test results will be displayed on the screen.

Refer to the following table and take the appropriate action as recommended by the Micro 570.



#### **Starter Test Results**

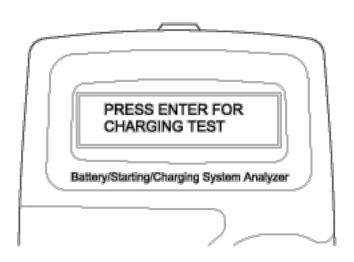
Result On Printer	Remedy
CRANKING VOLTAGE NORMAL	System shows a normal starter draw.
CRANKING VOLTAGE LOW	Cranking voltage is lower than normal level.  - Check starter.
CHARGE BATTERY	The state of battery charge is too low to test.  - Charge the battery and retest.
REPLACE BATTERY	Replace battery.  — If the vehicle is not started though the battery condition of "GOOD BATTERY" is displayed, check wiring for open circuit, battery cable connection, starter and repair or replace as necessary.
	- If the engine does crank, check fuel system.

## NOTICE

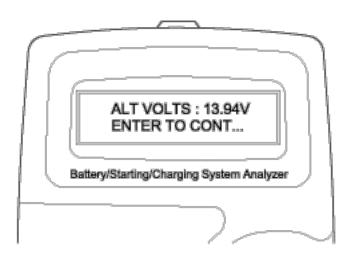
When testing the vehicle with old diesel engines, the test result will not be favorable if the glow plug is not heated. Conduct the test after warming up the engine for 5 minutes.

#### **Charging System Test Procedure**

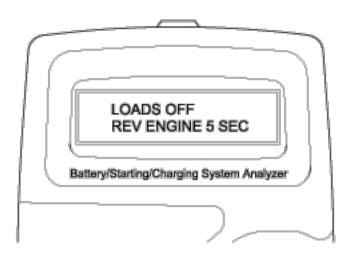
10. Press ENTER to begin charging system test.

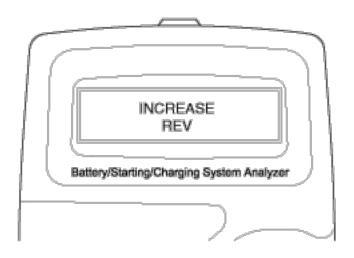


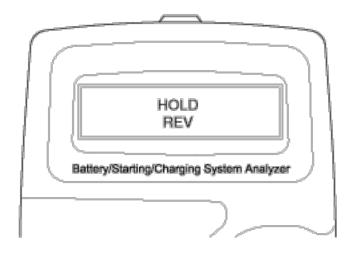
11. The tester displays the actual voltage of alternator. Press ENTER to continue.



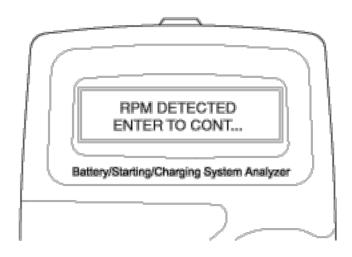
12. Turn off all electrical load and rev engine for 5 seconds with pressing the accelerator pedal. (Follow the instructions on the screen)



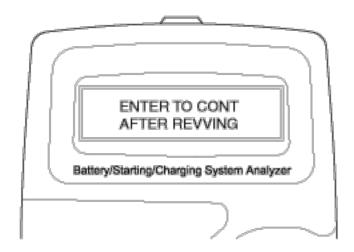




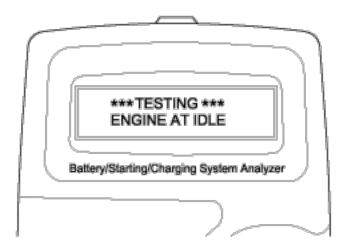
13. The message that engine RPM is detected will be displayed on the screen. Press ENTER to continue.

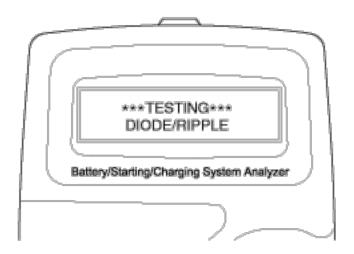


14. If the engine RPM is not detected, press ENTER after revving engine.

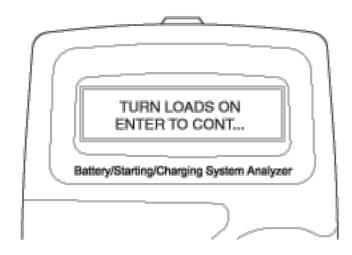


15. The tester will conduct charging system test during loads off.

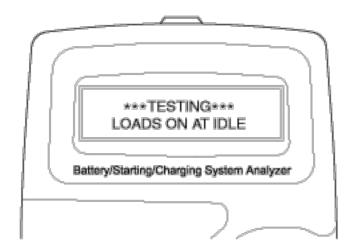




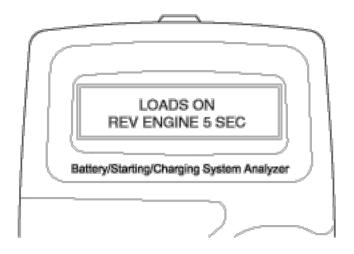
16. Turn on electrical loads (air conditioner, lamps, audio and etc). Press ENTER to continue.

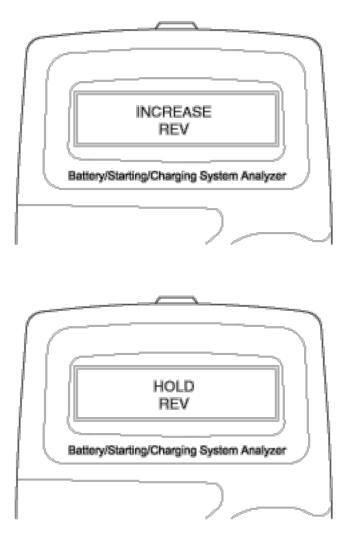


17. The tester will conduct charging system test during loads on.

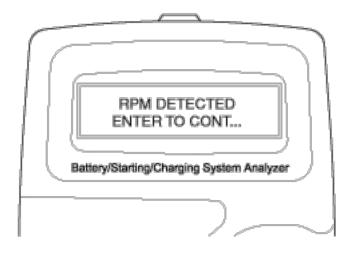


18. Rev engine for 5 seconds with pressing the accelerator pedal. (Follow the instructions on the screen)

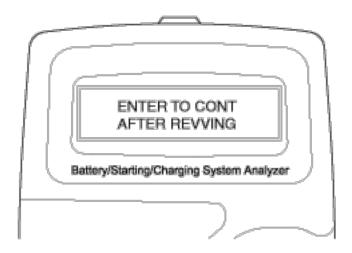




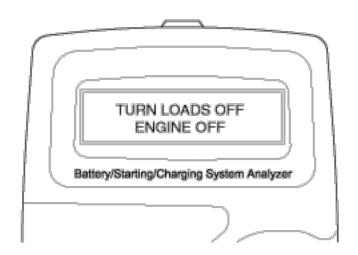
19. The message that engine RPM is detected will be displayed on the screen. Press ENTER to continue.



20. If the engine RPM is not detected, press ENTER after revving engine.

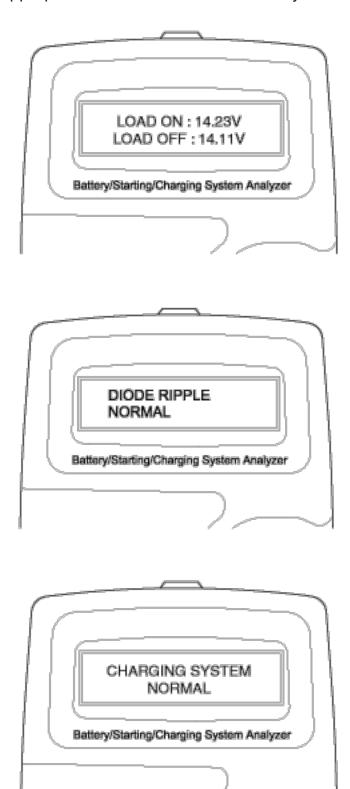


21. Turn off electrical loads (air conditioner, lamps, audio and etc). Turn the engine off.



22. Charging voltage and charging system test results will be displayed on the screen.

Shut off engine end disconnect the tester clamps from the battery. Refer to the following table and take the appropriate action as recommended by the Micro 570.



# **Charging System Test Results**

Result On Printer	Remedy			
CHARGING SYSTEM	Charging system is normal.			

NORMAL / DIODE RIPPLE NORMAL	
NO CHARGING VOLTAGE	Alternator does not supply charging current to battery.
	Check belts, connection between alternator and battery and replace belts or cable or alternator as necessary.
LOW CHARGING VOLTAGE	Alternator does not supply charging current to battery and electrical load to system fully.
	Check belts and alternator and replace as necessary.
HIGH CHARGING VOLTAGE	The voltage from alternator to battery is higher than normal limit during voltage regulating.
	Check connection and ground and replace regulator as necessary.
	Check electrolyte level in the battery.
EXCESS RIPPLE DETECTED	One or more diodes in the alternator is not functioning properly.  - Check alternator mounting and belts and replace as necessary.

# SPECIAL SERVICE TOOLS

Tool (Number and name)	Illustration	Use
Micro-570 Battery checker		<ul> <li>Check the battery condition</li> <li>Check the charging and starting system</li> </ul>
Drive belt remover & installer 09252-03100		Removal and installation of the full option type drive belt.Removal of the non-A/C type drive belt.
Drive belt installer (Non-A/C type) 09252-03200		Installation of the non-A/C type drive belt

#### **SPECIFICATIONL**

# **Ignition System**

Itei	ms	Specification		
Ignition coil	Primary resistance	0.82 ± 10 % (Ω)		
Ignition coil	Secondary resistance	15.5 ± 15 % (kΩ)		
Spark plugs	CHAMPION	RER8YC		
	Gap	0.8 ~ 0.9 mm (0.0315 ~ 0.0345 in.)		

# Starting System

Items			Specification		
Rated voltage			12 V, 0.9 kW		
	No. of pir	nion teeth	8		
Starter	Starter  No-load  characteristics	Voltage	11.5 V		
		Ampere	55A max		
		Speed	5,500 rpm min		

# **Charging System**

Items		Specification		
	Туре	Battery voltage sensing		
	Rate voltage	13.5 V , 70A		
Alternator	Speed in use	1,000 ~ 18,000 rpm		
Allemator	Voltage regulator	Electronic built-in type		
	Regulator setting voltage	14.7± 0.3 V		
	Temperature compensation	-7 ± 3 mV / °C		
Battery	Туре	32-20DL		
	Cold cranking amperage [at -18°C(-0.4°F)]	354 A		
	Reserve capacity	55 min		
	Specific gravity [at 20°C(68°F)]	1.280 ± 0.01		

# **▲** CAUTION

- COLD CRANKING AMPERAGE is the amperage a battery can deliver for 30 seconds and maintain a terminal voltage of 7.2V or greater at a specified temperature.
- RESERVE CAPACITY RATING is amount of time a battery can deliver 25A and maintain a minimum terminal voltage of 10.5V at 26.7°C(80.1°F).

- Battery type notation:	<u> </u>	2	3	<u>4</u>		
①:5HR capacity						
② : Battery length ③ : Battery width						
4 : Terminal location						

## **TROUBLE SHOOTING**

## **Ignition System**

Symptom	Suspect area	Remedy	
Engine will not start or is hard to start	Ignition lock switch	Inspect ignition lock switch, or replace as required	
(Cranks OK)	Ignition coil	Inspect ignition coil, or replace as required	
	Spark plugs	Inspect spark plugs, or replace as required	
	Ignition wiring disconnected or broken	Repair wiring, or replace as required	
	Spark plugs cable	Inspect cable, or replace as required	
Rough idle or stalls	Ignition wiring	Repair wiring, or replace as required	
	Ignition coil	Inspect ignition coil, or replace as required	
	Spark plugs cable	Inspect cable, or replace as required	
Engine hesitates/poor acceleration	Spark plugs and spark plug cables	Inspect spark plugs / cable, or replace as required	
	Ignition wiring	Repair wiring, or replace as required	
Poor mileage	Spark plugs and spark plug cables	Inspect spark plugs / cable, or replace as required	

Discharge

Charging System				
Symptom	Suspect area	Remedy		
Charging warning indicator does not light with ignition switch "ON" and engine off.	Fuse blown	Check fuses		
	Light burned out	Replace light		
	Wiring connection loose	Tighten loose connection		
	Electronic voltage regulator	Replace voltage regulator		
Charging warning indicator does not go out with engine running. (Battery requires frequent recharging)	Drive belt loose or worn	Adjust belt tension or replace belt		
	Battery cable loose, corroded or worn	Inspect cable connection, repair or replace cable		
	Electronic voltage regulator or alternator	Replace voltage regulator or alternator		
	Wiring	Repair or replace wiring		
Overcharge	Electronic voltage regulator	Replace voltage regulator		
	Voltage sensing wire	Repair or replace wiring		

Drive belt loose or worn

Poor grounding

Wiring connection loose or short circuit

Electronic voltage regulator or alternator

Adjust belt tension or replace belt

Inspect wiring connection, repair or

Replace voltage regulator or alternator

replace wiring

Inspect ground or repair

# Starting System

Symptom	Suspect area	Remedy
Engine will not crank	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn out	Repair or replace cables
	Transaxle range switch (Vehicle with automatic transaxle only)	Refer to A/T Group
	Fuse blown	Replace fuse
	Starter faulty	Replace
	Ignition switch faulty	Replace
Engine cranks slowly	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn out	Repair or replace cables
	Starter faulty	Replace
Starter keeps running	Starter	Replace
	Ignition switch	Replace
Starter spins but engine will not	Short in wiring	Repair wiring
crank	Pinion gear teeth broken or starter motor	Replace
	Ring gear teeth broken	Replace fly wheel or torque converter

2010 > G 1.2 DOHC > G 1.2 DOHC > Engine Electrical System > Ignition System > Description and Operation

# **DESCRITION**

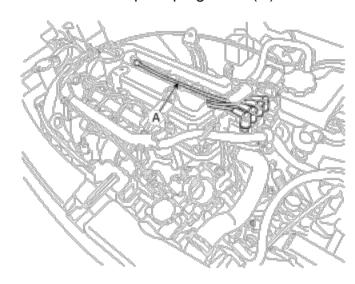
Ignition timing is controlled by the electronic control ignition timing system. The standard reference ignition timing data for the engine operating conditions are pre-programmed in the memory of the ECM (Engine Control Module).

The engine operating conditions (speed, load, warm-up condition, etc.) are detected by the various sensors. Based on these sensor signals and the ignition timing data, signals to interrupt the primary current are sent to the ECM. The ignition coil is activated, and timing is controlled.

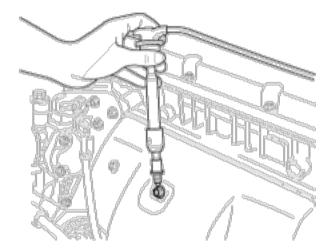
#### **ON-VEHICLE INSPECTION**

#### **Spark Test**

1. Disconnect the spark plug cable(A) from the spark plug.



- 2. Using a spark plug socket, remove the spark plug.
- 3. Install the spark plug to the spark plug cable.
- 4. Ground the spark plug to the engine.

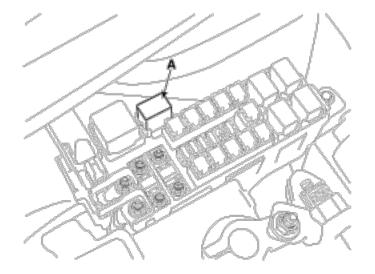


5. Check that spark occurs while engine is being cranked.

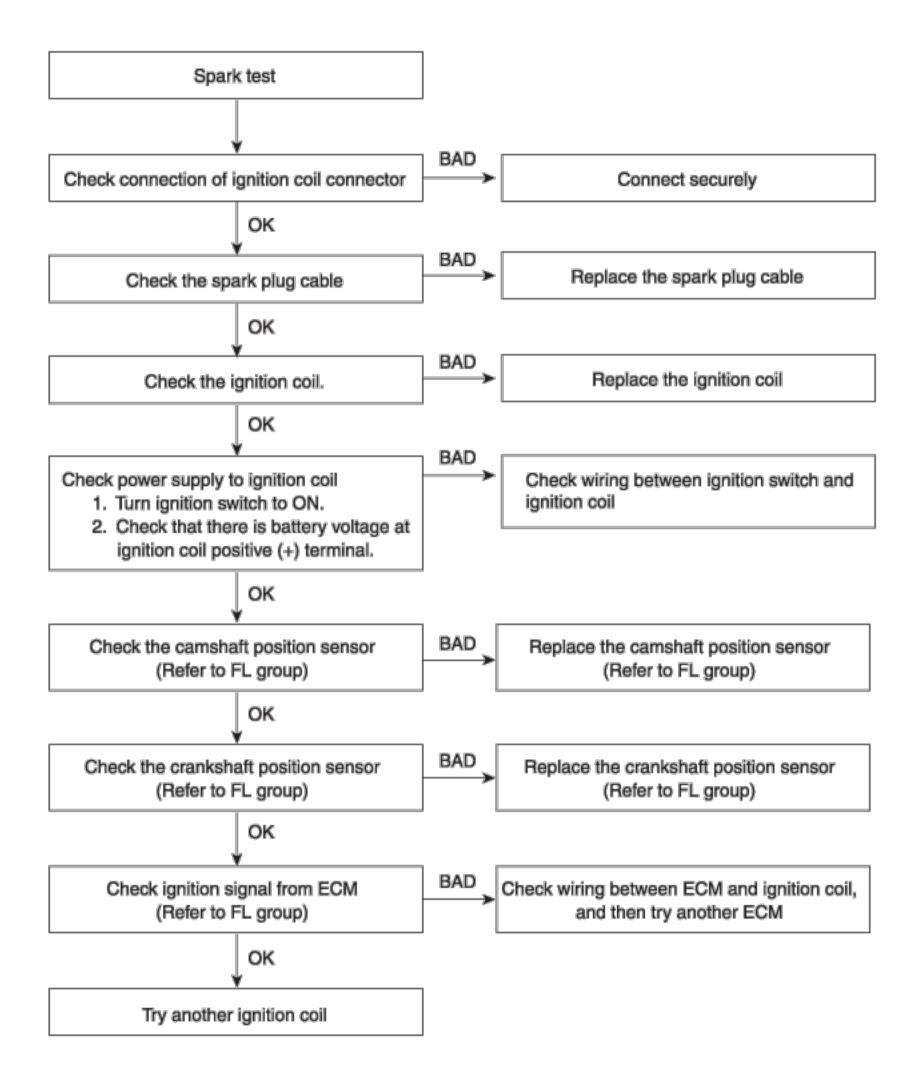
# NOTICE

To prevent fuel being injected from injectors while the engine is being cranked, remove the fuel pump relay (A) from the fuse box.

Crank the engine for no more than  $5 \sim 10$  seconds.



- 6. Inspect all the spark plugs.
- 7. Using a spark plug socket, install the spark plugs.
- 8. Install the spark plug cables.

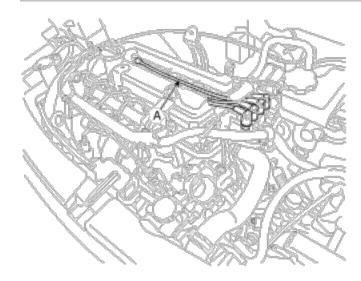


#### Inspect Spark Plug

1. Remove the spark plug cables (A).



When removing the spark plug cable, pull on the spark plug cable boot (not the cable), as it may be damaged.

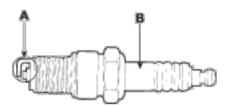


2. Using a spark plug socket, remove the spark plug.



Be careful that no contaminates enter through the spark plug holes.

3. Inspect the electrodes (A) and ceramic insulator (B).

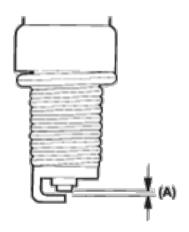


# **Inspection Of Electrodes**

Condition	Dark deposits	White deposits
Description	- Fuel mixture too rich - Low air intake	<ul><li>Fuel mixture too lean</li><li>Advanced ignition</li><li>timing</li><li>Insufficient plug tightening torque</li></ul>

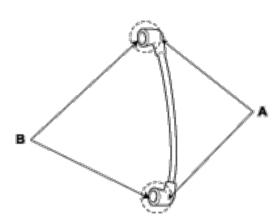
4. Check the electrode gap (A).

**Standard (New):** 0.8 ~ 0.9 mm (0.0315 ~ 0.0345 in.)



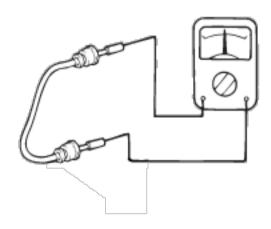
# **Inspect Spark Plug Cable**

1. Carefully remove the spark plug cable by pulling on the rubber boots (A). Check the condition of the spark plug cable terminals (B), if any terminal has surface corrosion, clean it off, and if it broken or distorted, replace the spark plug cable.



2. Connect the ohmmeter probes and measure resistance.

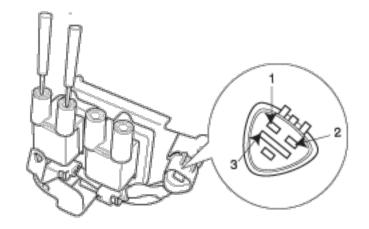
Spark plug cable				
Cylinder No.	Length (mm)	Resistance (kΩ)		
1	410	1.84 ~ 2.76		
2	300	1.34 ~ 2.02		
3	230	1.03 ~ 1.55		
4	155	0.7 ~ 1.04		



3. Resistance should not be higher than  $10k\Omega/m$ . If resistance is higher, replace the cable.

# **Inspect Ignition Coil**

1. Measure the primary coil resistance between terminals 1, 2 and 1, 3



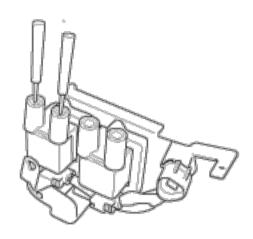
Standard value:  $0.82\Omega \pm 10\%$ 

2. Measure the secondary coil resistance between the high-voltage terminals for the No.1 and No. 4 cylinders, and between the high voltage terminals for the No. 2 and No. 3 cylinders.

Standard value:  $15.5k\Omega/m \pm 15\%$ 

# **▲** CAUTION

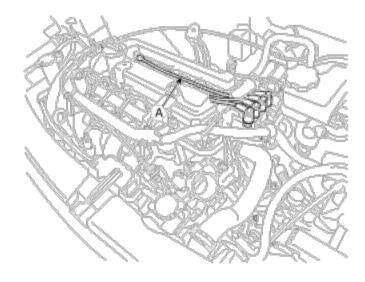
Be sure, when measuring the resistance of the secondary coil, to disconnect the connector of the ignition coil.



## **REPLACEMENT**

### **Ignition Coil**

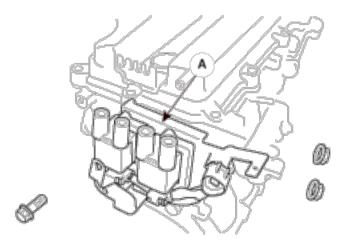
1. Disconnect the spark plug cables (A) and ignition coil connector.



2. Remove the ignition coil (A).

#### **Tightening torque:**

18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lbf.ft)





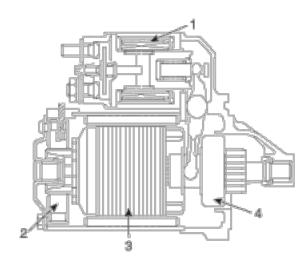
## **DESCRIPTION**

The starting system includes the battery, starter, solenoid switch, ignition switch, inhibitor switch (A/T), ignition lock switch, connection wires and the battery cable.

When the ignition key is turned to the start position, current flows and energizes the starter motor's solenoid coil.

The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear.

The contacts close and the starter motor cranks. In order to prevent damage caused by excessive rotation of the starter armature when the engine starts, the clutch pinion gear overruns.



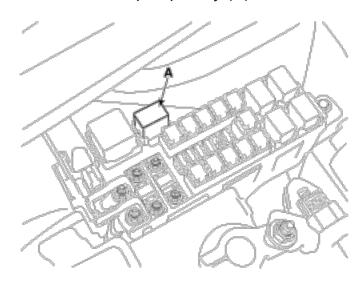
- 1. Solenoid
- 2. Brush
- 3. Armature
- 4, Over running clutch

#### STARTER CIRCUIT TROUBLE SHOOTING

### NOTICE

The battery must be in good condition and fully charged.

1. Remove the fuel pump relay (A) from the fuse box.



2. With the shift lever in N or P (A/T) or clutch pedal pressed (M/T), turn the ignition switch to START.

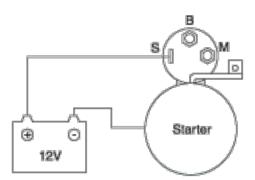
If the starter cranks the engine normally, starting system is OK. If the starter will not crank the engine at all, go to next step.

If it won't disengage from the ring gear when you release key, check for the following until you find the cause.

- Solenoid plunger and switch malfunction.
- Dirty pinion gear or damaged overrunning clutch.
- 3. Check the battery condition. Check electrical connections at the battery, battery negative cable connected to the body, engine ground cables, and the starter for looseness and corrosion. Then try starting the engine again. If the starter cranks the engine normally, repairing the loose connection repaired the problem. The starting system is now OK.
  - If the starter still does not crank the engine, go to next step.
- 4. Disconnect the connector from the S-terminal of solenoid. Connect a jump wire from the B-terminal of solenoid to the S-terminal of solenoid.
  - If the starter cranks the engine, go to next step.
  - If the starter still does not crank the engine, remove the starter, and repair or replace as necessary.
- 5. Check the following items in the order listed until you find the open circuit.
  - Check the wire and connectors between the driver's under-dash fuse/relay box and the ignition switch, and between the driver's under-dash fuse/relay box and the starter.
  - Check the ignition switch (Refer to Ignition system in BE group)
  - Check the transaxle range switch connector or ignition lock switch connector.
  - Inspect the starter relay.

#### Stater Solenoid Test

- 1. Disconnect the field coil wire from the M-terminal of solenoid switch.
- 2. Connect a 12V battery between S-terminal and the starter body.



3. Connect the field coil wire to the M-terminal.

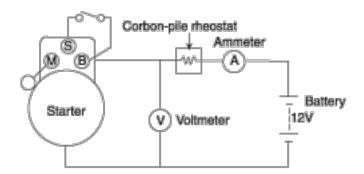
# **▲** CAUTION

This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

- 4. If the pinion moves out, the pull-in coil of solenoid is working properly. If the pinion does not move, replace the solenoid.
- 5. Disconnect the field coil wire from the M-terminal.
- 6. If the pinion has moved out, the hold-in coil of the solenoid is working properly. If the pinion moves in, replace the solenoid.

## **Free Running Test**

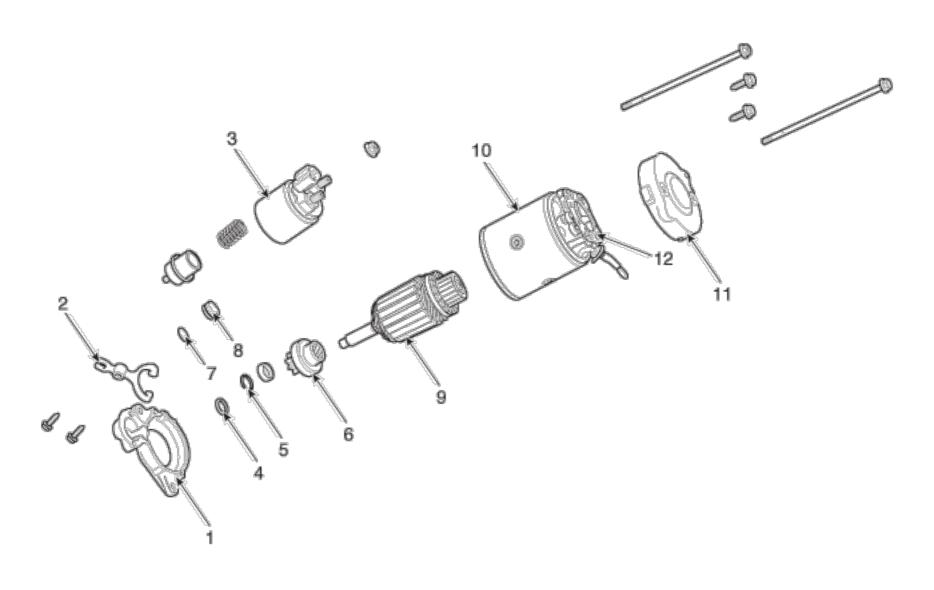
- 1. Place the starter in a vise equipped with soft jaws and connect a fully-charged 12-volt battery to starter as follows:
- 2. Connect a test ammeter (100-ampere scale) and carbon pile rheostats shown is the illustration.
- 3. Connect a voltmeter (15-volt scale) across starter.



- 4. Rotate carbon pile to the off position.
- 5. Connect the battery cable from battery's negative post to the starter body.
- 6. Adjust until battery voltage shown on the voltmeter reads 11volts.
- 7. Confirm that the maximum amperage is within the specifications and that the starter turns smoothly and freely.

**Current:** 55A MAX **Speed:** 5,500 RPM

# **COMPONENT**

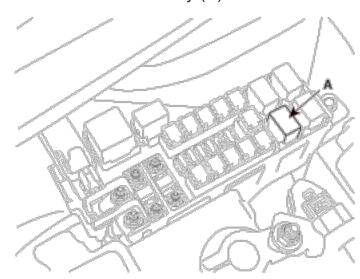


- 1. Front bracket assembly
- 2, Lever
- 3, Magnet switch assembly
- 4. Stop ring
- 5. Stopper
- 6. Overrunning clutch

- 7. Plate
- 8. Lever packing
- 9. Armature assembly
- 10. Yoke assembly
- 11. Rear bracket
- 12. Brush holder assembly

# **INSPECTION**

- 1. Remove the fuse box cover.
- 2. Remove the starter relay (A).

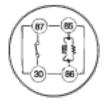


3. Using an ohmmeter, check that there is continuity between each terminal.

Terminal	Continuity
30 - 87	NO
85 - 86	YES

4. Apply 12V to terminal 85 and ground to terminal 86. Check for continuity between terminal 30 and 87.





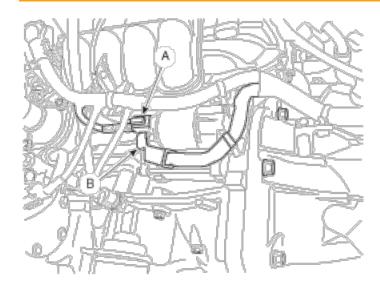
- 5. If there is no continuity, replace the starter relay.
- 6. Install the starter relay.
- 7. Install the fuse box cover.

## **REPLACEMENT**

- 1. Disconnect the battery negative terminal first, then the positive terminal.
- 2. Disconnect the connector (A) from the S terminal ,and remove the cable (B) from the B terminal.
- 3. Remove the 2 bolts holding the starter, and then remove the starter.

#### **Tightening torque**

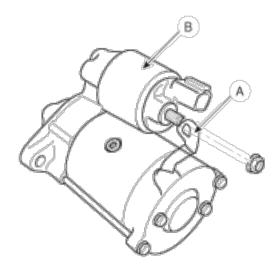
42.2 ~ 53.9 N.m (4.3 ~ 5.5 kgf.m, 31.1 ~ 39.8lb-ft)



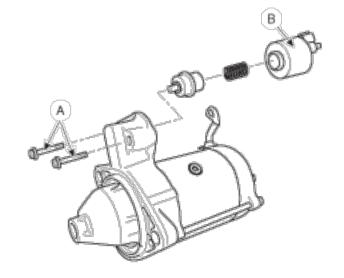
- 4. Installation is the reverse of removal.
- 5. Connect the battery cable to the battery.

## **DISASSEMBLY**

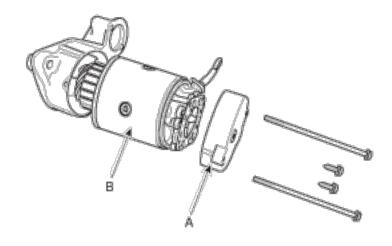
1. Disconnect the M-terminal (A) on the magnet switch assembly (B).



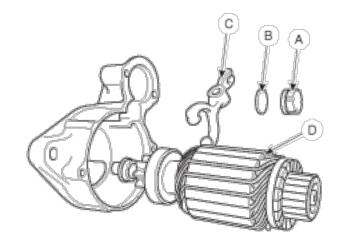
2. After loosening the 2 screws (A), detach the magnet switch assembly (B).



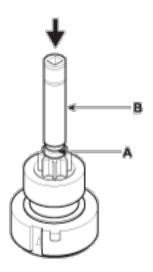
3. Loosen the screws and through bolts, and then remove the rear bracket (A) and yoke (B).



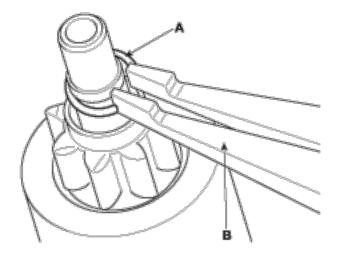
4. Remove the packing (A), lever plate (B), lever (C) and armature assembly (D).



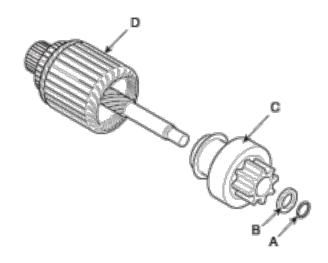
5. Press the stop ring (A) using a socket (B).



6. After removing the stopper (A) using stopper pliers (B).



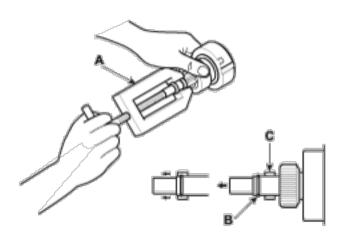
7. Remove the stopper (A), stop ring (B), overrunning clutch (C) and armature (D).



8. Reassembly is the reverse of disassembly.

## NOTICE

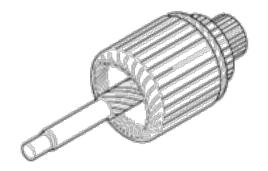
Using a suitable pulling tool (A), pull the overrunning clutch stop ring (B) over the stopper (C).



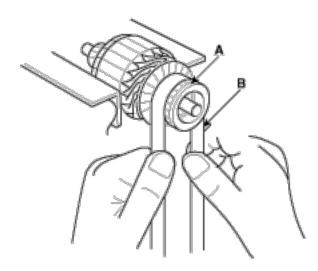
#### **INSPECTION**

#### **Armature Inspection And Test**

- 1. Remove the starter.
- 2. Disassemble the starter as shown at the beginning of this procedure.
- 3. Inspect the armature for wear or damage from contact with the permanent magnet. If there is wear or damage, replace the armature.



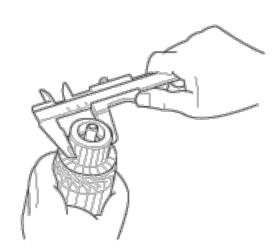
4. Check the commutator (A) surface. If the surface is dirty or burnt, resurface with emery cloth or a lathe within the following specifications, or recondition with #500 or #600 sandpaper (B).



5. Check the commutator diameter. If the diameter is below the service limit, replace the armature.

#### **Commutator diameter**

Standard (New): 33.0mm (1.2992in.) Service limit: 32.4mm (1.2756in.)

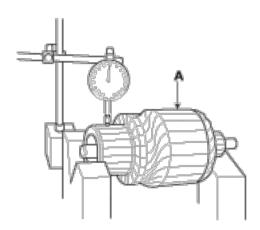


- 6. Measure the commutator (A) runout.
  - If the commutator runout is within the service limit, check the commutator for carbon dust or brass chips between the segments.
  - If the commutator run out is not within the service limit, replace the armature.

#### **Commutator runout**

Standard (New): 0.02mm (0.0008in.), max

Service limit: 0.05mm (0.002in.)

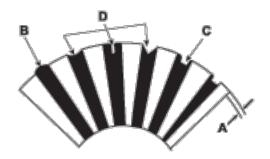


7. Check the mica depth (A). If the mica is too high (B), undercut the mica with a hacksaw blade to the proper depth. Cut away all the mica (C) between the commutator segments. The undercut should not be too shallow, too narrow, or v-shaped (D).

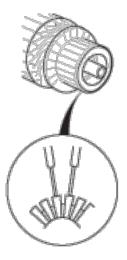
## Commutator mica depth

Standard (New): 0.5mm (0.0197in.)

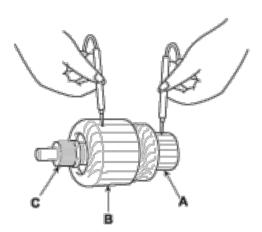
Limit: 0.2mm (0.0079in.)



8. Check for continuity between the segments of the commutator. If an open circuit exists between any segments, replace the armature.

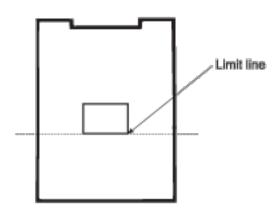


9. Check with an ohmmeter that no continuity exists between the commutator (A) and armature coil core (B), and between the commutator and armature shaft (C). If continuity exists, replace the armature.



## **Inspect Starter Brush**

Brushes that are worn out, or oil-soaked, should be replaced.

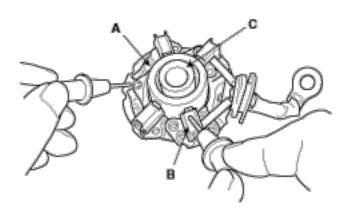


### NOTICE

The seat new brushes, slip a strip of #500 or #600 sandpaper, with the grit side up, between the commutator and each brush, and smoothly rotate the armature. The contact surface of the brushes will be sanded to the same contour as the commutator.

## Starter Brush Holder Test

1. Make sure there is no continuity between the (+) brush holder (A) and (-) plate (B). If there is continuity, replace the brush holder assembly.

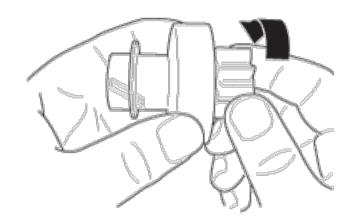


### NOTICE

Use a pipe (C) of suitable size for the brushes not to get removed from the brush holder.

# **Inspect Overrunning Clutch**

- Slide the overrunning clutch along the shaft. Replace it if does not slide smoothly.
- Rotate the overrunning clutch both ways.Does it lock in one direction and rotate smoothly in reverse? If it does not lock in either direction of it locks in both directions, replace it.



3. If the starter drive gear is worn or damage, replace the overrunning clutch assembly. (the gear is not available separately)

Check the condition of the flywheel or torque converter ring gear if the starter drive gear teeth are damaged.

## Cleaning

- 1. Do not immerse parts in cleaning solvent. Immersing the yoke assembly and/or armature will damage the insulation. Wipe these parts with a cloth only.
- 2. Do not immerse the drive unit in cleaning solvent. The overrunning clutch is pre-lubricated at the factory and solvent will wash lubrication from the clutch.
- 3. The drive unit may be cleaned with a brush moistened with cleaning solvent and wiped dry with a cloth.

#### REPLACEMENT AND AIR BLEEDING

# **▲** WARNING

Never remove the radiator cap when the engine is hot. Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

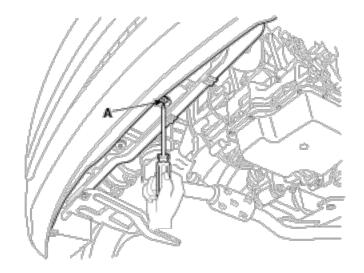
## **▲** CAUTION

When pouring engine coolant, be sure to shut the relay box lid and not to let coolant spill on the electrical parts or the paint. If any coolant spills, rinse it off immediately.

- 1. Make sure the engine and radiator are cool to the touch.
- 2. Loosen the drain plug (A), and drain the coolant.

### NOTICE

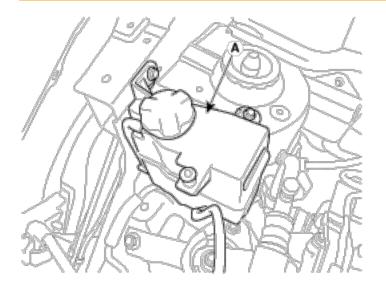
Remove the radiator cap to speed draining.



- 3. Tighten the radiator drain plug (A) securely.
- 4. Remove the coolant reservoir tank. Drain the coolant and reinstall the coolant reservoir tank. Fill the coolant reservoir tank to the MAX mark with the coolant.

## Tightening torque:

 $6.9 \sim 10.8$ Nm  $(0.7 \sim 1.1$ kgf.m,  $5.1 \sim 7.9$ lb-ft)



5. Fill the radiator with water through the radiator cap and tighten the cap.

## NOTICE

To most effectively bleed the air, pour the water slowly and press on the upper/lower radiator hoses.

- 6. Start the engine and allow to come to normal operating temperature. Wait for the cooling fans to turn on several times. Accelerate the engine to aid in purging trapped air. Shut engine off.
- 7. Wait until the engine is cool.
- 8. Repeat steps 1 to 7 until the drained water runs clear.
- 9. Fill fluid mixture with coolant and water(5 : 5) (Tropical region 4:6) slowly through the radiator cap. Push the upper/lower hoses of the radiator so as bleed air easily.

#### NOTICE

- · Use only genuine antifreeze/coolant.
- For best corrosion protection, the coolant concentration must be maintained year-round at 35% minimum. Coolant concentrations less than 35% may not provide sufficient protection against corrosion or freezing.
- Coolant concentrations greater then 60% will impair cooling efficiency and are not recommended.

## **▲** CAUTION

- · Do not mix different brands of antifreeze/coolants.
- Do not use additional rust inhibitors or antirust products; they may not be compatible with the coolant.
- The coolant should be mixed with soft water. (demineralized and distilled water)
- 10. Start the engine and run coolant circulates.

When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.

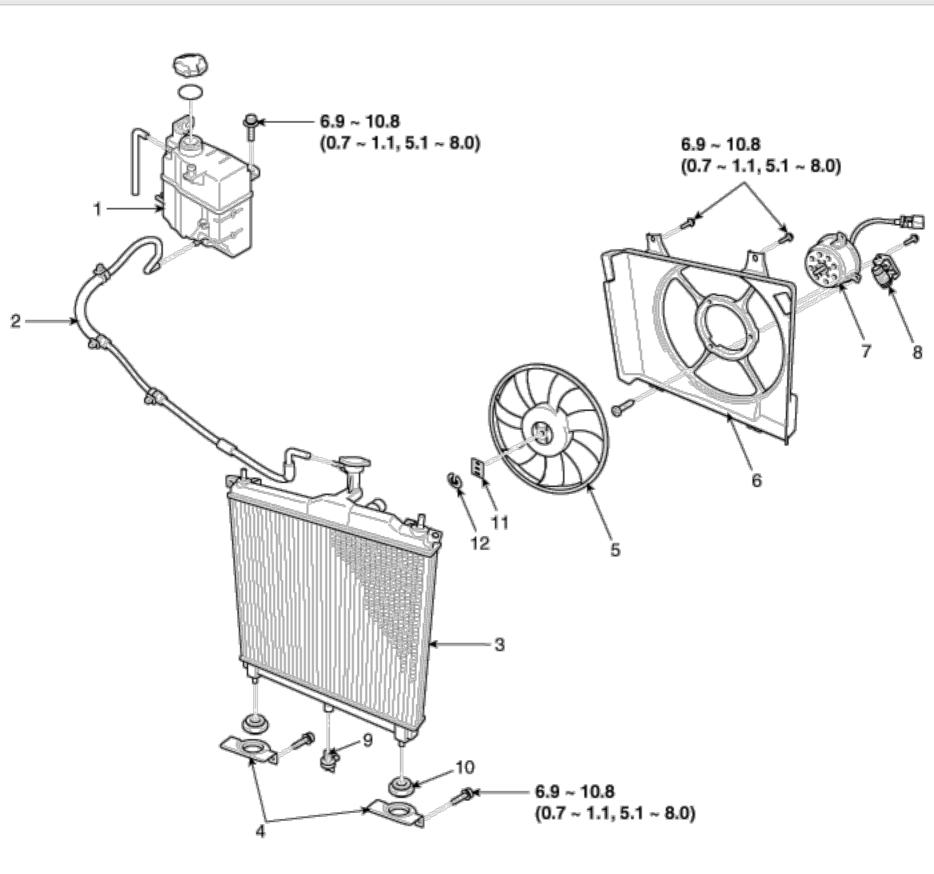
- 11. Repeat step10 until the cooling fan 3 ~ 5times and bleed air sufficiently out of the cooling system.
- 12. Install the radiator cap and fill the reservoir tank to the "MAX" line with coolant.
- 13. Run the vehicle under idle until the cooling fan operates 2 ~ 3 times.
- 14. Stop the engine and wait coolant gets cool.
- 15. Repeat 9 to 14 until the coolant level doesn't fall any more, bleed air out of the cooling system.

### NOTICE

As it is to bleed air out to the cooling system and refill coolant when coolant gets cool completely, recheck the coolant level in the reservoir tank for  $2 \sim 3$  days after replacing coolant.

Coolant capacity: 4.2L (4.43US qt, 3.69 lmp qt)

## **COMPONENTS**



Torque: N.m (kgf.m, lb-ft)

1. Reservior tank	
-------------------	--

- 2. Reservior hose
- 3. Radiator
- 4. Radiator mounting bracket
- 5. Cooling fan
- 6. Cooling fan shroud
- 7. Cooling fan motor
- 8. Cooling fan resister

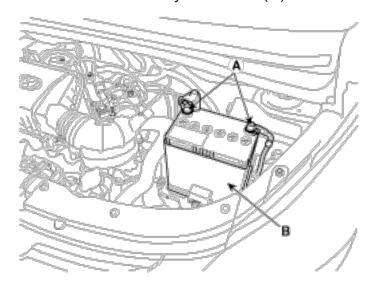
- 9. Mounting insulator
- 10. Radiator mounting insulator
- 11. Washer
- 12. Retainer

# **REMOVAL**



Never remove the radiator cap when the engine is hot. Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

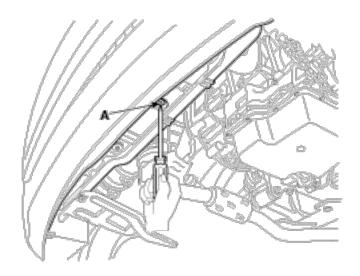
1. Disconnect the battery terminals (A) from the battery (B).



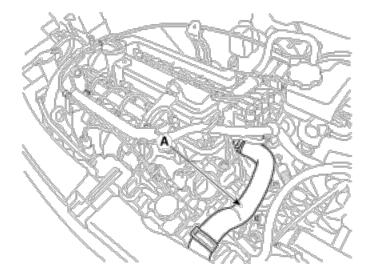
2. Loosen the drain plug (A), and drain the coolant.

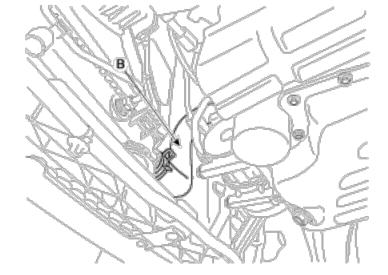
## NOTICE

Remove the radiator cap to speed draining.

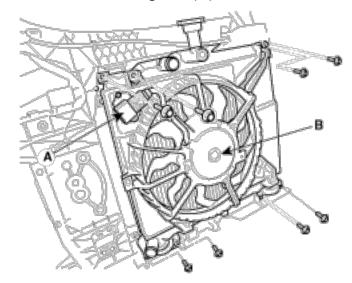


3. Remove the radiator upper hose (A), lower hose (B) and reservoir hose.





- 4. Remove the radiator assembly.
  - (1) Disconnect the fan motor connector (A).
  - (2) Remove the cooling fan (B) from the radiator.

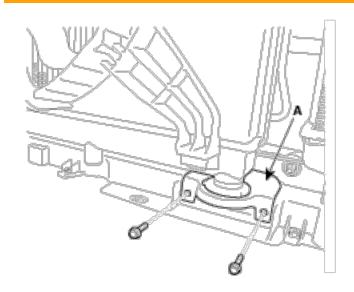


(3) Remove the mounting brackets (A).

## Tightening torque:

bolts:

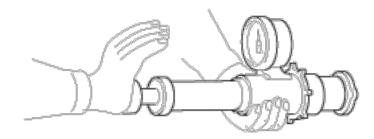
6.8~10.8Nm (0.7 ~1.1kgf.m, 5.1~7.9lb-ft)



- (4) Remove the radiator from the vehicle.
- 5. Installation is reverse order of removal.
- 6. Fill with engine coolant.
- 7. Start the engine and check for leaks.
- 8. Recheck the engine coolant level.

# **Radiator Cap Testing**

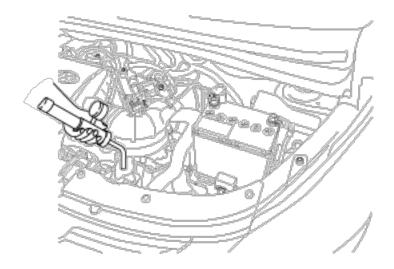
1. Remove the radiator cap, wet its seal with engine coolant, then install it on the pressure tester.



- 2. Apply a pressure of 93.16  $\sim$  122.58kpa (0.95  $\sim$  1.25kg/cm<sup>2</sup>, 13.51  $\sim$  17.78psi)
- 3. Check for a drop in pressure.
- 4. If the pressure drops, replace the cap.

## Radiator Leakage Test

- 1. Wait until engine is cool, then carefully remove the radiator cap and fill the radiator with engine coolant.
- 2. Install a pressure tester to the radiator and apply a pressure of 93.16  $\sim$  122.58kpa (0.95  $\sim$  1.25kg/cm<sup>2</sup>, 13.51  $\sim$  17.78psi).



- 3. Inspect for engine coolant leaks and a drop in pressure.
- 4. Remove the tester and reinstall the radiator cap.

## NOTICE

Check for engine oil in the coolant and/or coolant in the engine oil.

### **REMOVAL**

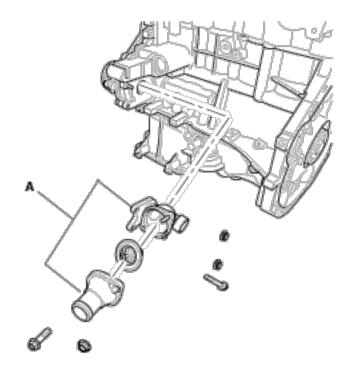
## NOTICE

Disassembly of the thermostat would have an adverse effect, causing a lowering of cooling efficiency.

- 1. Drain the engine coolant so its level is below thermostat.
- 2. Remove the water inlet fitting (A) and the thermostat (B).

#### Tightening torque:

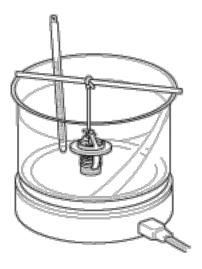
Thermostat housing bolt & nut  $9.8 \sim 11.8 \text{Nm} (1.0 \sim 1.2 \text{kgf.m}, 7.2 \sim 8.7 \text{lb-ft})$  Water inlet fitting bolt & nut  $19.6 \sim 26.5 \text{Nm} (2.0 \sim 2.7 \text{kgf.m}, 14.5 \sim 19.5 \text{lb-ft})$ 



- 3. Installation is reverse order of removal.
- 4. Fill with engine coolant.
- 5. Start the engine and check for leaks.
- 6. Recheck the engine coolant level.

### **INSPECTION**

1. Immerse the thermostat in water and gradually heat the water.



2. Check the valve opening temperature.

Valve opening temperature: 82±1.5°C (179.6±2.7°F)

Full opening temperature : 95°C (203°F)

3. Check the valve lift.

Valve lift: 8mm(0.3in) or more at 95°C (203°F)

# **TROUBLESHOOTING**

Sym	ptoms	Poss	Remedy		
Coolant leakage • From the thermostat	thermostat	Check the mounting bolts	Check the torque of the mounting bolts	<ul> <li>Retighten the bolts and check leakage again.</li> </ul>	
	gasket	Check the gasket for damage	Check gasket or seal for damage	<ul> <li>Replace gaskets and reuse the thermostat.</li> </ul>	
Cooled excessively	<ul> <li>Low heater performance (cool air</li> </ul>	Visually check after removing the radiator cap.	Insufficient coolant or leakage.	After refilling coolant, recheck.	
• Thermogauge indicates 'LOW'	Thermogauge indicates	GDS check&Starting engine	<ul> <li>Check DTCs</li> <li>Check connection of the fan clutch or the fan motor.</li> <li>If the fan clutch is always connected, there will be a noise at idle.</li> </ul>	<ul> <li>Check the engine coolant sensor, wiring and connectors.</li> <li>Replace the componants.</li> </ul>	
		Remove the thermostat and inspect	Check if there are dusts or chips in the thermostat valve.	<ul> <li>Clean the thermostat valve and reuse the thermostat.</li> </ul>	
			Check adherence of the thermostat.	<ul> <li>Replace the thermostat, if it doesn't work properly.</li> </ul>	
Heated excessively  • Engine overheated • Thermogauge indicates 'HI'	Visually check after removing the radiator cap.	<ul> <li>Insufficient coolant or leakage.</li> <li>* Be careful when removing a radiator cap of the overheated vehicle.</li> <li>Check air in cooling system.</li> </ul>	<ul> <li>After refilling coolant, recheck.</li> <li>Check the cylinder head gaskets for damage and the tightening torque of the mounting bolts.</li> </ul>		
		GDS check&Starting engine	<ul> <li>Check DTCs</li> <li>Check the fan motor performance as temperature varies.</li> <li>Check if the fan clutch slips.</li> <li>Check the water pump adherence or impeller damaged.</li> </ul>	<ul> <li>Check the engine coolant sensor, wiring and connectors.</li> <li>Check the fan motor, the relay and the connector.</li> <li>Replace the fan clutch, if it doesn't work properly.</li> <li>Replace the water pump, if it doesn't work properly.</li> </ul>	

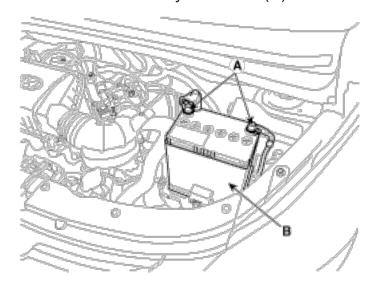
		Immerse the thermostat in boiling water and inspection.	<ul> <li>After removing the thermostat, check it works properly.</li> <li>* Check the thermostat opens at the valve opening temperature.</li> </ul>	<ul> <li>Replace the thermostat, if it doesn't work properly.</li> </ul>
<u> </u>	<u> </u>			

## **REMOVAL**



Never remove the radiator cap when the engine is hot. Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

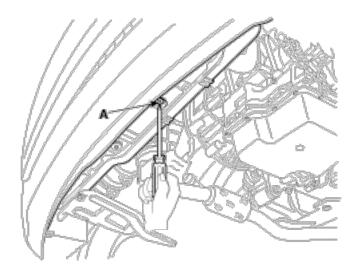
1. Disconnect the battery terminals (A) from the battery (B).



2. Loosen the drain plug (A), and drain the coolant.

## NOTICE

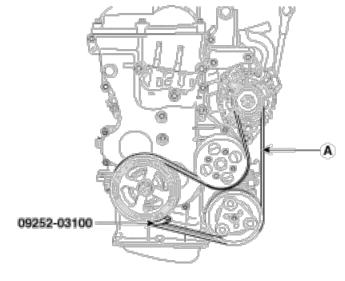
Remove the radiator cap to speed draining.



3. Remove the drive belt (A).

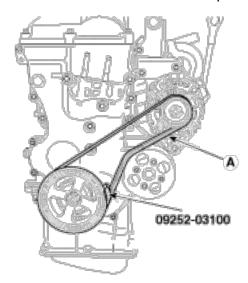
# [Full-option type]

- (1) Insert the SST(09252-03100) between the crankshaft pulley and the drive belt.
- (2) Rotate 2 revolutions of crankshaft pulley into clockwise direction. And then remove the drive belt.



# [Non- A/C type]

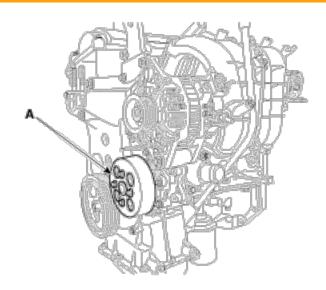
- (3) Insert the SST(09252-03100) between the crankshaft pulley and the drive belt.
- (4) (2) Rotate 2 revolutions of crankshaft pulley into clockwise direction. And then remove the drive belt.



4. Remove the water pump pulley (A).

## **Tightening torque:**

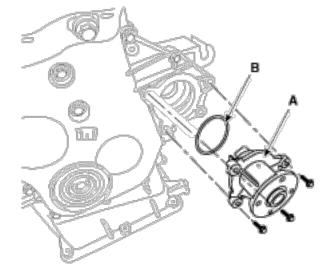
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



5. Remove the water pump (A) and O-ring (B).

### Tightening torque:

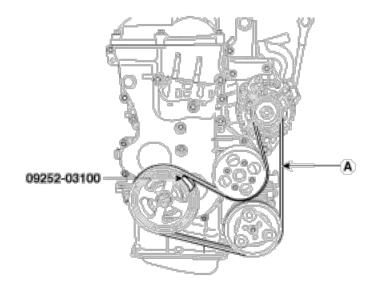
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



- 6. Installation is reverse order of removal.
- 7. Install the drive belt (A).

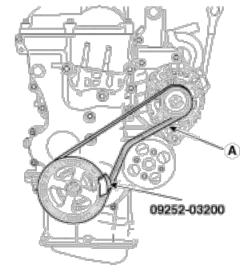
## [Full-option type]

- (1) Pre-position the drive belt on the water pump, alternator, A/C compressor pulleys. Make sure the belt is properly fitted on groove pulleys of alternator and A/C compressor.
- (2) Insert the SST(09252-03100) between the crankshaft pulley and the drive belt.
- (3) Rotate 2 revolutions of crankshaft pulley into counterclockwise direction.
- (4) Remove the tool and make sure the belt is properly installed.



# [Non-A/C type]

- (5) Pre-position the drive belt on the water pump, alternator pulleys. Make sure the belt is properly fitted on groove pulley of alternator.
- (6) Insert the SST(09252-03200) between the crankshaft pulley and the drive belt.
- (7) Rotate 2 revolutions of crankshaft pulley into clockwise direction.
- (8) Remove the tool and make sure the belt is properly installed.



# NOTICE

The belt must be free from any harmful damage during installation.

- 8. Fill with engine coolant.
- 9. Start the engine and check for leaks.
- 10. Recheck the engine coolant level.

# **TROUBLESHOOTING**

# Water Pump

Overheating

Damaged

impeller

Loosened

Symptoms		Possible	Causes	Remedy	
Coolant leakage	From the bleed hole of the water	Visually check	Check leaks after about ten-minute	<ul> <li>If coolant still leaks, replace a water pump.</li> </ul>	
	pump		warming up.	<ul> <li>If leakage stops, reuse the water pump (Do not replace the pump with a new one).</li> </ul>	
	From gaskets or bolts		Check the tightening of the water pump mounting bolts.	Retighten the mounting bolts.	
			Check damage of gaskets or inflow of dust.	Replace the gasket and clean dust off.	
	<ul> <li>From outer surface of water pump</li> </ul>		Check the material or any cracks of the water pump.	<ul> <li>Poor material. If any crack found, replace the water pump.</li> </ul>	
Noise	<ul> <li>From bearings</li> <li>From mechanical seals</li> <li>Impeller interference</li> </ul>	Inspection with a stethoscope	After starting the engine, check noise with a stethoscope.	<ul> <li>If there is no noise, reuse the water pump (do not replace it).</li> </ul>	
				<ul> <li>If there is any noise from the water pump, remove the drive belt and recheck.</li> </ul>	
		Inspection after removing a drive belt	After removing a water pump and a drive belt, check noise again.	If there is noise, reuse the water pump. Check other drive line parts.	
				If there is no noise,     replace the water pump     with a new one.	
		Inspection after removing a water pump	After removing a water pump and a drive belt, check noise again.	If there is any interference between them, replace the water pump with a new one.	

Loosened impeller

• Corrosion of the

impeller wing

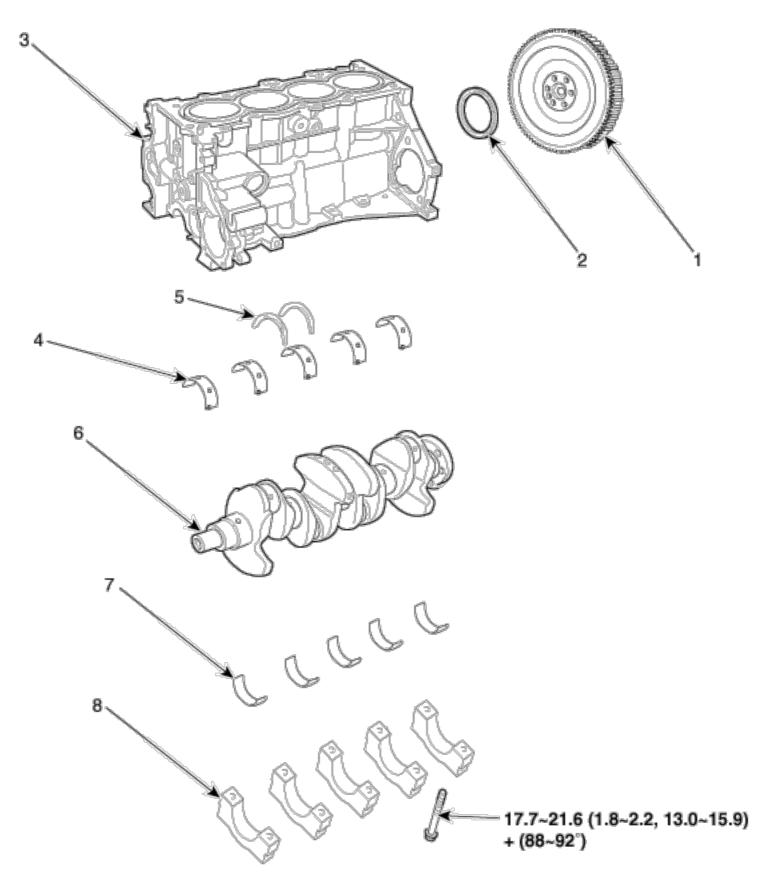
• Check engine coolant.

Poor coolant quality /

Maintenance check

impeller	Impeller     seperation from     the shaft	Replace the water pump.

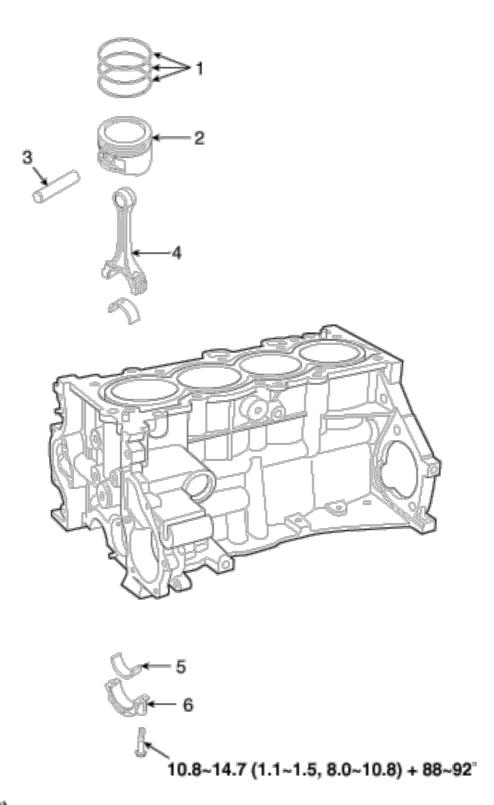
## **COMPONENTS**



Torque: N.m (kgf.m, lb-ft)

- 1. Flywheel
- 2. Rear oil seal
- 3. Cylinder block
- 4. Main bearing (Upper)

- 5. Thrust bearing
- 6. Crankshaft
- 7. Main bearing (Lower)
- 8. Main bearing cap



# Torque : N.m (kgf.m, lb-ft)

1. Piston ring	4. Connecting rod
2. Piston	5. Connecting rod bearing
3. Piston pin	6. Connecting rod cap

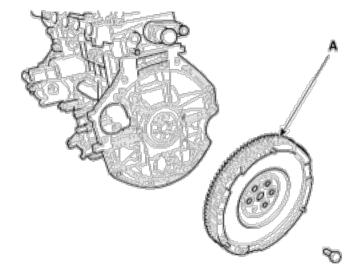
### **DISASSEMBLY**

## **▲** CAUTION

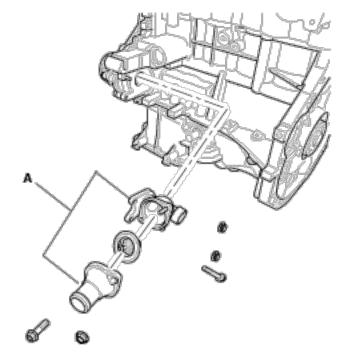
- Use fender covers to avoid damaging painted surfaces
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

## NOTICE

- Mark all wiring and hoses to avoid misconnection.
- Inspect the timing belt before removing the cylinder head.
- Turn the crankshaft pulley so that the No.1 piston is at top dead center.
- Engine removal is required for this procedure.
- Remove the engine assembly from the vehicle.
   (Refer to Engine and transaxle assembly in this group)
- 2. Remove the flywheel (A).

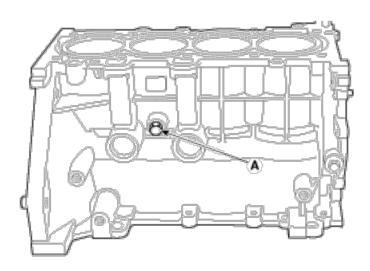


- 3. Install the engine to engine stand for disassembly.
- 4. Remove the intake manifold and exhaust manifold. (Refer to Intake and exhaust system in this group)
- 5. Remove the timing chain. (Refer to Timing system in this group)
- 6. Remove the cylinder head. (Refer to Cylinder head in this group)
- 7. Remove the water temperature control assembly (A).



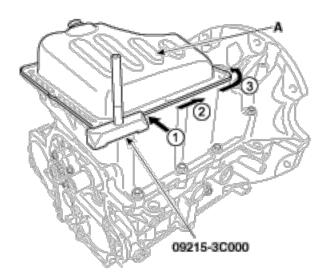
## NOTICE

Remove the drain plug (A) and drain the engine coolant.



8. Remove the oil pan (A).

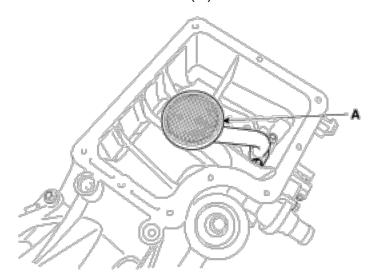
Insert the blade of SST(09215-3C000) between the ladder frame and the oil pan. Cut off applied sealer and remove the oil pan.



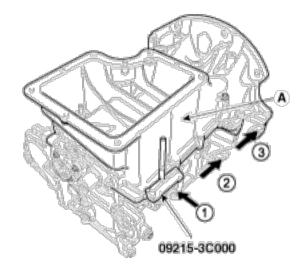
## NOTICE

- Insert the SST between the ladder frame and the oil pan by tapping it with a plastic hammer in the direction of (1) arrow.
- After tapping the SST with a plastic hammer along the direction of (2) arrow around more than 2/3 edge of the oil pan, remove it from the oil pan.
- Do not turn over the SST abruptly without tapping. It be result in damage of the SST.

- Be careful not to damage the contact surfaces of ladder frame and oil pan.
- 9. Remove the oil screen (A).



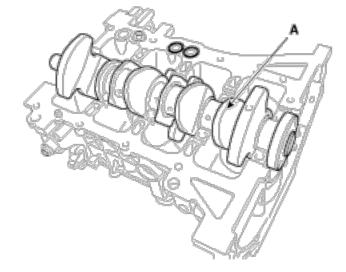
10. Remove the ladder frame (A).
Insert the blade of SST(09215-3C000) between the cylinder block and the ladder frame. Cut off applied sealer and remove the ladder frame.



- 11. Check the connecting rod end play.
- 12. Remove the connecting rod caps and check oil clearance.
- 13. Check the connecting rod cap oil clearance.
- 14. Remove the piston and connecting rod assemblies.
  - (1) Using a ridge reamer, remove all the carbon from the top of the cylinder.
  - (2) Remove the connecting rod cap.
  - (3) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

## NOTICE

- Keep the bearings, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in the correct order.
- 15. Remove the main bearing caps and check oil clearance.
- 16. Check the crankshaft end play.
- 17. Lift the crankshaft (A) out of engine, being careful not to damage journals.



## NOTICE

Arrange the main bearings and center bearings in the correct order.

- 18. Check fit between piston and piston pin.
  - Try to move the piston back and forth on the piston pin. If any movement is felt, replace piston and piston pin as a set.
- 19. Remove the piston rings.
  - (1) Using a piston ring expander, remove the 2 compression rings.
  - (2) Remove 2 side rails and the spacer by hand.

## NOTICE

Arrange the piston rings in the correct order only.

20. Remove the connecting rod from the piston.

Using a press, remove the piston pin from the piston.

**Press-in load**: 300 ~ 1300kg (661 ~ 2866lb)

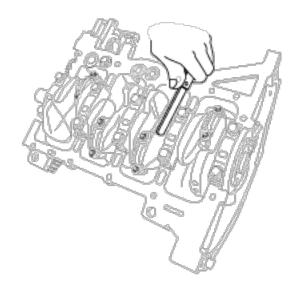
### **INSPECTION**

## **Connecting Rod And Crankshaft**

Check the connecting rod end play.
 Using a feeler gauge, measure the end play while moving the connecting rod back and forth.

## Standard end play:

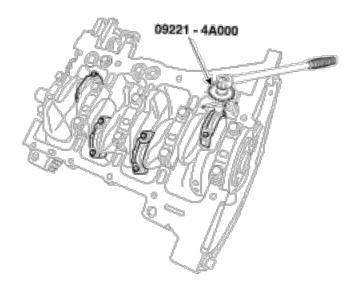
0.10 ~ 0.25mm (0.0039 ~ 0.0098in)



- (1) If out-of-tolerance, install a new connecting rod.
- (2) If still out-of-tolerance, replace the crankshaft.
- 2. Check the connecting rod bearing oil clearance.
  - (1) Check the match marks on the connecting rod and cap are aligned to ensure correct reassembly.
  - (2) Remove the 2 connecting rod cap bolts.
  - (3) Remove the connecting rod cap and lower bearing.
  - (4) Clean the crank pin journal and bearing.
  - (5) Place a plastigage across the crankshaft pin journal.
  - (6) Reinstall the lower bearing and cap, and tighten the bolts.

#### **Tightening torque:**

10.8~14.7Nm (1.1~1.5kgf.m, 8.0~10.8lb-ft) + 88~92°



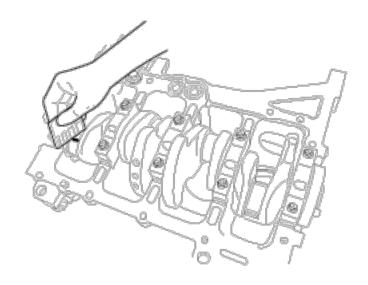
## NOTICE

Do not turn the crankshaft.

- (7) Remove the 2 bolts, connecting rod cap and lower bearing.
- (8) Measure the plastigage at its widest point.

#### Standard oil clearance

 $0.018 \sim 0.036$ mm  $(0.0007 \sim 0.0014$ in)



(9) If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark (Refer to connecting rod bearing selection table)

Recheck the oil clearance.



Do not file, shim, or scrape the bearings or the caps to adjust clearance.

(10) If the plastigage shows the clearance is still incorrect, try the next lager or smaller bearing. (Refer to connecting rod bearing selection table Recheck the oil clearance.

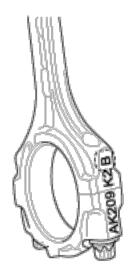
## NOTICE

If the proper clearance cannot be obtained by using the appropriate lager or smaller bearings, replace the crankshaft and start over.

# **▲** CAUTION

If the alignment marks are unreadable because of an accumulation of grease or grime, don't clean with a wire or abrasive cleaner. Clean only with correct cleaning solvent or detergent.

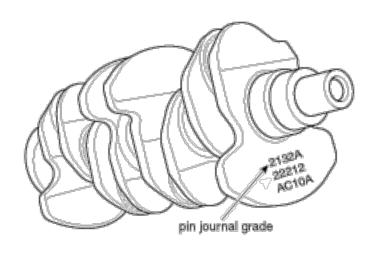
## **Connecting Rod Mark Location**



# **Discrimination Of Connecting Rod**

Grade	Mark	Connecting Rod Big-end Inner Diameter
0	А	42.000 ~ 42.006mm (1.6535 ~ 1.6540in)
1	В	42.006 ~ 42.012mm (1.6537 ~ 1.6540in)
2	С	42.012 ~ 42.018mm (1.6540 ~ 1.6542in)

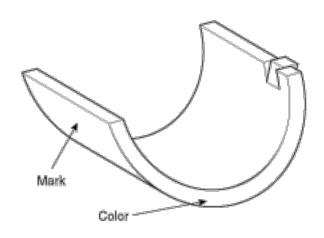
### **Crankshaft Pin Journal Mark Location**



# **Discrimination Of Crankshaft Pin Journal**

Class	Mark	Crankshaft Pin Journal outer Diameter		
I	1	38.966 ~ 38.972mm (1.5340 ~ 1.5343in)		
II	2	38.960 ~ 38.966mm (1.5338 ~ 1.5340in)		
III	3	38.954 ~ 38.960mm (1.7698 ~ 1.7701in)		

# **Connecting Rod Bearing Mark Location**



# **Discrimination Of Connecting Rod Bearing**

Grade	Color	Connecting Rod Bearing Thickness
А	Blue	1.514 ~ 1.517mm (0.0596 ~ 0.0597in)
В	Black	1.511 ~ 1.514mm (0.0595 ~ 0.0596in)
С	None	1.508 ~ 1.511mm (0.0594 ~ 0.0595in)
D	Green	1.505 ~ 1.508mm (0.0593 ~ 0.0594in)
E	Yellow	1.502 ~ 1.505mm (0.0591 ~ 0.0593in)

(11) Select the bearing by using selection table.

# **Connecting Rod Bearing Selection Table**

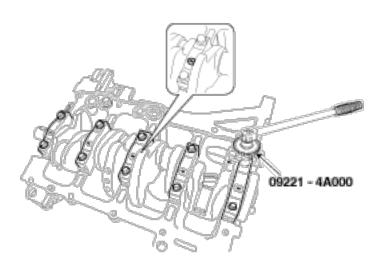
Connecting Rod Bearing		Connecting Rod Mark		
		0(A)	1(B)	2(C)
Crank shaft pin journal	l(1)	E(Yellow)	D(Green)	C(Red)
mark	II(2)	D(Green)	C(Red)	B(Black)
	III(3)	C(Red)	B(Black)	A(Blue)

3. Check the crankshaft main bearing oil clearance.

- (1) To check main bearing-to-journal oil clearance, remove the main bearings.
- (2) Clean each main journal and bearing half with a clean shop tower.
- (3) Place one strip of plastigage across each main journal.
- (4) Use the SST( 09221-4A000 ), reinstall the bearings and bolts as following method with specified torque.

### Tightening torque:

17.7~21.6Nm (1.8~2.2kgf.m, 13.0~15.9lb-ft) + 88~92°



(5) Remove the cap and bearing again, and measure the widest part of the plastigage.

#### Standard oil clearance:

 $0.006 \sim 0.024 \text{ mm} (0.0002 \sim 0.0009 \text{in})$ 

(6) If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

# **▲** CAUTION

Do not file, shim, or scrape the bearings or the caps to adjust clearance.

(7) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

### NOTICE

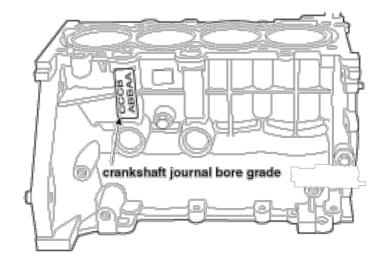
If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

# **▲** CAUTION

If the marks are indecipherable because of an accumulation of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.

#### Cylinder block crankshaft journal bore mark location

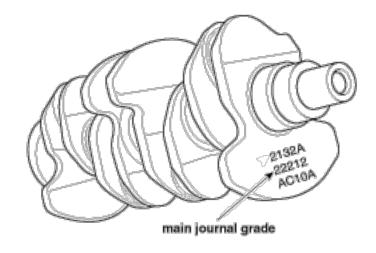
Letters have been stamped on the block as a mark for the size of each of the 5 main journal bores. Use them, and the numbers or bar stamped on the crank (marks for main journal size), to choose the correct bearings.



# **Discrimination Of Cylinder Block Crankshaft Journal Bore**

Grade	Mark	Cylinder Block Crankshaft journal Bore Inner Diameter
а	А	47.000 ~ 47.006mm (1.8503 ~ 1.8506in)
b	В	47.006 ~ 47.012mm (1.8506 ~ 1.8508in)
С	С	47.012 ~ 47.018mm (1.8508 ~ 1.8511in)

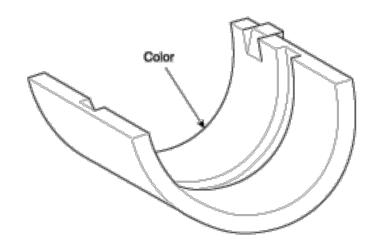
# **Crankshaft Main Journal Mark Location**



# **Discrimination Of Crankshaft Main Journal**

Class	Mark	Crankshaft main journalouter diameter	
I	1	42.954 ~ 42.960mm (1.6911 ~ 1.6913in)	
II	2	42.948 ~ 42.954mm (1.6908 ~ 1.6911in)	
III	3	42.942 ~ 42.948mm (1.6906 ~ 1.6908in)	

# **Crankshaft Main Bearing Mark Location**



# **Discrimination Of Crankshaft Main Bearing**

Mark	Color	Crankshaft Main Bearing Thickness
А	Blue	2.026 ~ 2.029mm (0.0797 ~ 0.0798in)
В	Black	2.023 ~ 2.026mm (0.0796 ~ 0.0797in)
С	None	2.020 ~ 2.023mm (0.0795 ~ 0.0796in)
D	Green	2.017 ~ 2.020mm (0.0794 ~ 0.0795in)
Е	Yellow	2.014 ~ 2.017mm (0.0793 ~ 0.0794in)

(8) Select the bearing by using selection table.

# **Crankshaft Main Bearing Selection Table**

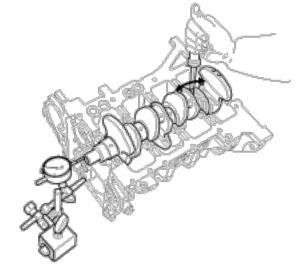
Crankshaft Main Bearing		Cylinder Block Crankshaft Journal Bore Mark		
		a (A)	b (B)	c (C)
Crank shaft main journal	I (1)	E(Yellow)	D(Green)	C(None)
mark	II (2)	D(Green)	C(None)	B(Black)
	III (3)	C(None)	B(Black)	A(Blue)

4. Check crankshaft end play.

Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

## Standard end play:

 $0.05 \sim 0.25 \text{ mm} (0.0019 \sim 0.0098 \text{in})$ 



If the end play is greater than maximum, replace the center bearings as a set.

### Thrust bearing thickness:

1.925 ~ 1.975mm (0.0757 ~ 0.0777in)

#### Crankshaft end play:

0.05 ~ 0.25mm (0.0019 ~ 0.0098in)

5. Inspect the crankshaft main journals and pin journals.

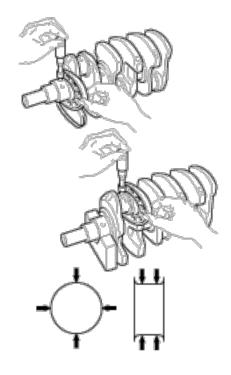
Using a micrometer, measure the diameter of each main journal and pin journal.

#### Main journal diameter:

42.942 ~ 42.960mm (1.6906 ~ 1.6913in)

#### Pin journal diameter:

38.954 ~ 38.972mm (1.5336 ~ 1.5343in)



## Cylinder Block

Remove the gasket material.
 Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.

2. Clean the cylinder block.

Using a soft brush and solvent, thoroughly clean the cylinder block.

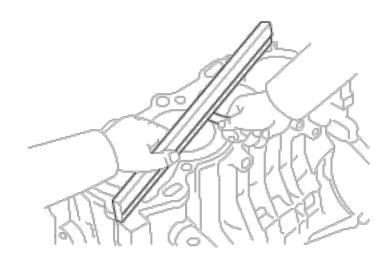
3. Inspect the top surface of the cylinder block for flatness.

Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

### Flatness of cylinder block gasket surface

Standard: Less than 0.05mm (0.002in),

Less than 0.02mm (0.0008in) / 100 x 100 (3.937 x 3.937in)



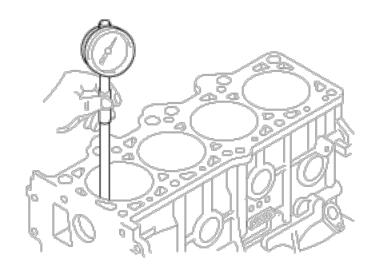
Inspect the cylinder bore.
 Visually check the cylinder for vertical scratchs.
 If deep scratchs are present, replace the cylinder block.

5. Inspect the cylinder bore diameter.

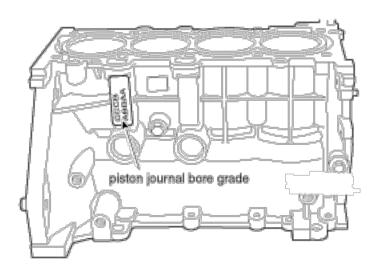
Using a cylinder bore gauge, measure the cylinder bore diameter at position in the thrust and axial direction.

### Standard diameter:

71.00 ~ 71.03mm (2.7952 ~ 2.7964in)



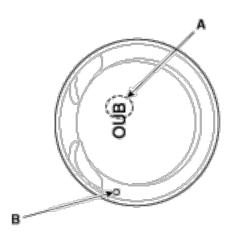
6. Check the cylinder bore size code on the cylinder block.



# Discrimination of cylinder bore size

Grade	Size code	Cylinder Bore inner Diameter
а	А	71.00 ~ 71.01mm (2.7952 ~ 2.7956in)
b	В	71.01 ~ 71.02mm (2.7956 ~ 2.7960in)
С	С	71.02 ~ 71.03mm

7. Check the piston size code(A) and the front mark(B) on the piston top face.



## **Discrimination Of Piston Outer Diameter**

Grade	Size code	Piston Outer Diameter
а	А	70.970 ~ 70.980mm (2.7940 ~ 2.7944in)
b	В	70.980 ~ 70.990mm (2.7944 ~ 2.7948in)
С	С	70.990 ~ 71.000mm (2.7948 ~ 2.7952in)

8. Select the piston related to cylinder bore class.

#### Clearance:

0.02 ~ 0.04mm (0.0008 ~ 0.0016in)

# Piston And Rings

- 1. Clean the piston
  - (1) Using a gasket scraper, remove the carbon from the piston top.
  - (2) Using a groove cleaning tool, clean the piston ring grooves.
  - (3) Using solvent and a brush, thoroughly clean the piston.

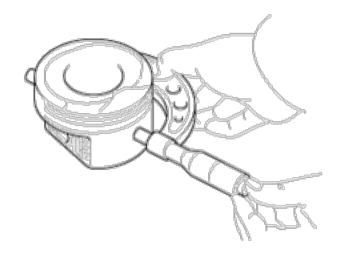


Do not use a wire brush.

2. The standard measurement of the piston outside diameter is taken 30.8mm (1.21in) from top land of the piston.

#### Standard diameter

70.970 ~ 71.000mm (2.7940 ~ 2.7952in)



3. Calculate the difference between the cylinder bore diameter and the piston diameter.

### Piston-to-cylinder clearance:

 $0.02 \sim 0.04$ mm ( $0.0008 \sim 0.0016$ in)

4. Inspect the piston ring side clearance.

Using a feeler gauge, measure the clearance between new piston ring and the wall of the ring groove.

### Piston ring groove width

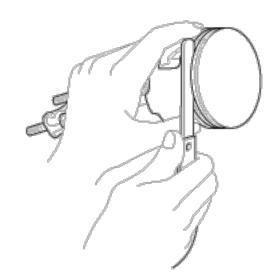
No.1 : 1.03 ~ 1.05mm (0.0405 ~ 0.0413in) No.2 : 1.23 ~ 1.25mm (0.0484 ~ 0.0492in) Oil ring : 2.01 ~ 2.03mm (0.0791 ~ 0.0799in)

#### **Piston ring width**

No.1: 0.97~ 0.99mm (0.0381 ~ 0.0389in) No.2: 1.17 ~ 1.19mm (0.0460 ~ 0.0468in) Oil ring: 1.91 ~ 1.97mm (0.0751 ~ 0.0775in)

### Piston ring side clearance

No.1: 0.04 ~ 0.08mm (0.0015 ~ 0.0031in) No.2: 0.04 ~ 0.08mm (0.0015 ~ 0.0031in) Oil ring: 0.04 ~ 0.12mm (0.0015 ~ 0.0047in)



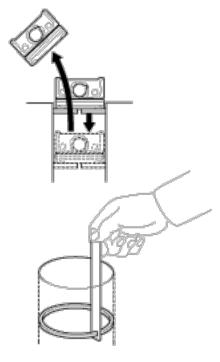
If the clearance is greater than maximum, replace the piston.

#### 5. Inspect piston ring end gap.

To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring. If the gap is too large, recheck the cylinder bore diameter against the wear limits. If the bore is over the service limit, the cylinder block must be replaced.

#### Piston ring end gap

No.1: 0.13 ~ 0.25mm (0.0051 ~ 0.0098in) No.2: 0.30 ~ 0.45mm (0.0118 ~ 0.0177in) Oil ring: 0.10 ~ 0.40mm (0.0039 ~ 0.0157in)



### **Piston Pins**

1. Measure the diameter of the piston pin.

Piston pin outer diameter:

18.000 ~ 18.003mm (0.7086 ~ 0.7087in)

Piston pin hole diameter:

18.013 ~ 18.017mm (0.7091 ~ 0.7093in)

Connecting rod small end inner diameter:

17.974 ~ 17.985mm (0.7076 ~ 0.7080in)



2. Measure the piston pin-to-piston clearance.

Piston pin-to-piston clearance:

 $0.010 \sim 0.017$ mm ( $0.0004 \sim 0.0006$ in)

3. Check the difference between the piston pin outer diameter and the connecting rod small end inner diameter.

Piston pin-to-connecting rod interference:

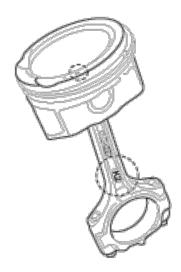
 $0.015 \sim 0.029$ mm ( $0.0006 \sim 0.0014$ in)

### **REASSEMBLY**

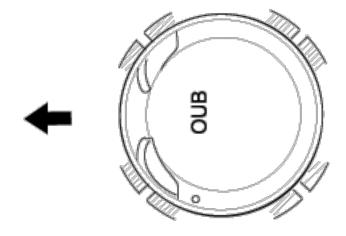
### **NOTICE**

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.

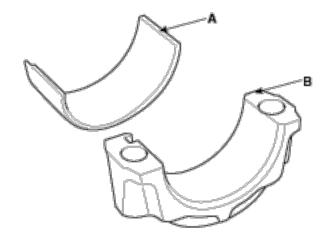
- 1. Assemble the piston and connecting rod.
  - (1) Use a hydraulic press for installation.
  - (2) The piston front mark and the connecting rod front mark must face the timing belt side of the engine.



- 2. Install the piston rings.
  - (1) Install the oil ring expender and 2 side rails by hand.
  - (2) Using a piston ring expender, install the 2 compression rings with the code mark facing upward.
  - (3) Position the piston rings so that the ring ends are as shown.



- 3. Install the connecting rod bearings.
  - (1) Align the bearing claw with the groove of the connecting rod and connecting rod cap.
  - (2) Install the bearings (A) in the connecting rod and connecting rod cap (B).

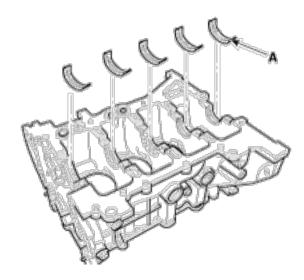


4. Install the crankshaft main bearings.

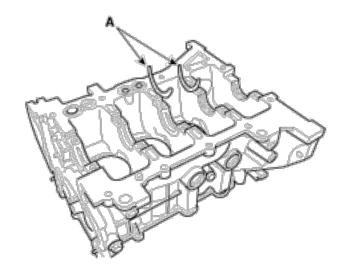
## NOTICE

Upper bearings have an oil groove of oil holes; Lower bearings do not.

(1) Align the bearing claw with the claw groove of the cylinder block, push in the 5 upper bearings (A).

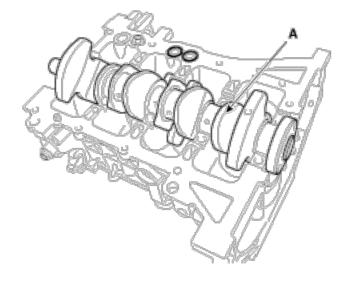


(2) Install the thrust bearings.
Install the 2 thrust bearings (A) under the No.3 journal position of the cylinder block with the oil grooves facing outward.



- (3) Install the crankshaft lower main bearing.

  Align the bearing claw with the groove of the crankshaft lower bearing and crankshaft main bearing cap.
- 5. Place the crankshaft (A) on the cylinder block.



6. Install the main bearing cap (A).

# NOTICE

- Always use new main bearing cap bolts.
- If any of the bearing cap bolts are broken or deformed, replace it.

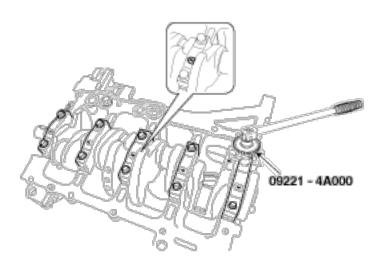
- (1) Apply a light coat of engine oil on the threads and under the bearing cap bolts.
- (2) Install and uniformly tighten the 10 bearing cap bolts, in several passes, in the sequence shown.

### Tightening torque:

17.7~21.6Nm (1.8~2.2kgf.m, 13.0~15.9lb-ft) + 88~92°

### NOTICE

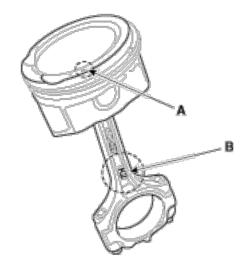
Using the SST(09221-4A000), tighten the bolts which need to be tightened with the angular tightening method.



- (3) Check that the crankshaft turns smoothly.
- 7. Check that the crankshaft end play.
- 8. Install the piston and connecting rod assemblies.

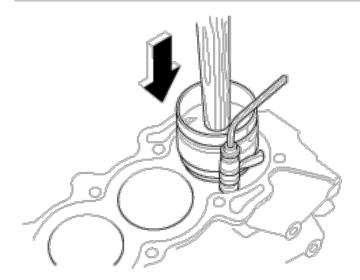
### **NOTICE**

- Before installing the pistons, apply a coat of engine oil to the ring grooves and cylinder bores.
- The piston front mark (A) and the connecting rod front mark (B) must face the timing chain side of the engine.



- (1) Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.
- (2) Stop after the ring compressor pops free, and check the connecting rod to check journal alignment before pushing the piston into place.
- (3) Apply engine oil to the bolt threads. Install the rod caps with bearings, and tighten the bolts.

- · Always use new connecting rod bearing cap bolts.
- Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.

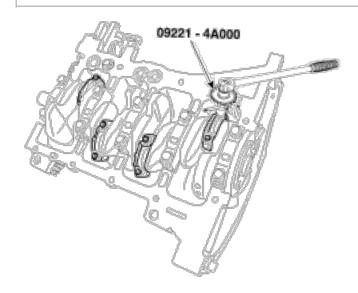


# Tightening torque:

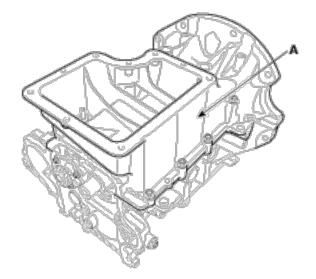
10.8~14.7Nm (1.1~1.5kgf.m, 8.0~10.8lb-ft) + 88~92°

# NOTICE

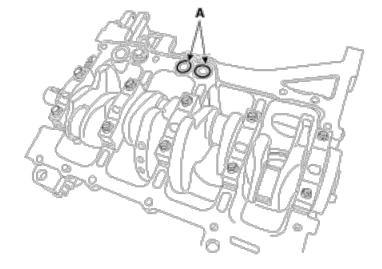
Using the SST(09221-4A000), tighten the bolts which need to be tightened with the angular tightening method.



9. Install the ladder frame (A).

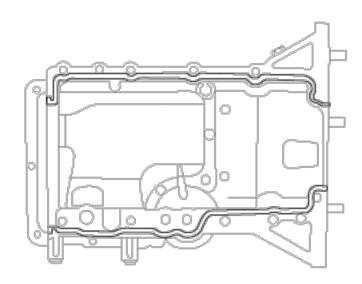


- (1) Using a gasket scraper, remove all the old packing material.
- (2) Install the O-ring (A) to cylinder block.



(3) Before assembling the ladder frame, the liquid sealant TB1217H should be applied on ladder frame. The part must be assembled within 5 minutes after the sealant was applied.

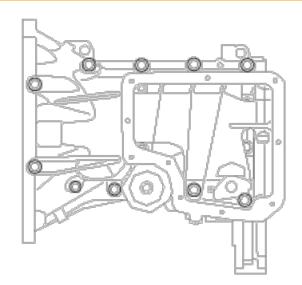
**Bead width:** 2.5 ~ 3.5mm (0.1 ~ 0.14in)



(4) Install and uniformly tighten the ladder frame bolts, in several passes.

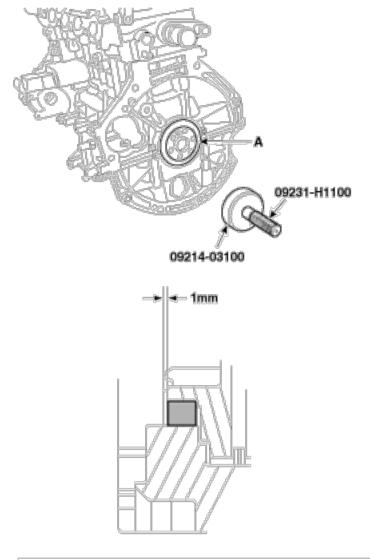
## **Tightening torque:**

19.6 ~ 23.5Nm (2.0 ~ 2.4kgf.m, 14.5 ~ 17.4lb-ft)



10. Using the SST(09214-03100, 09231-H1100) and a plastic hammer, tap in a new oil seal(A) until SST surface is flush with the cylinder block.

At this time, the depth of the oil seal(A) from the cylinder block surface is 1mm(0.039in).

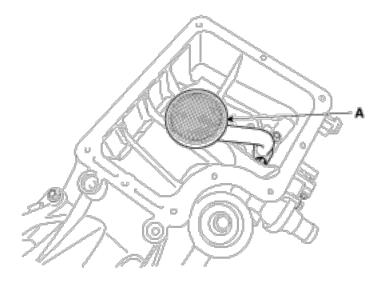


### NOTICE

- Before assembling oil seal, the hardened sealant or injurious material located on the boundary area between cylinder block and ladder frame must be removed.
- Apply engine oil to a new oil seal lip.
- When pressing oil seal, confirm to direction and take care not to damage oil seal.
- 11. Install the oil screen (A) with a new gasket.

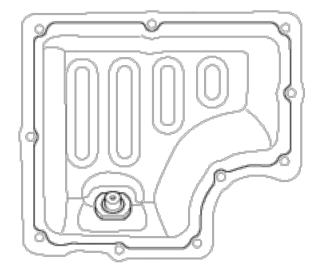
### Tightening torque:

 $19.6 \sim 26.5$ Nm ( $2.0 \sim 2.7$ kgf.m,  $14.5 \sim 19.5$ lb-ft)



- 12. Install the lower oil pan.
  - (1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
  - (2) Before assembling the oil pan, the liquid sealant TB1217H or LT5900H should be applied on lower oil pan. The part must be assembled within 5 minutes after the sealant was applied.

**Bead width:** 3.0 ~ 4.0mm (0.12 ~ 0.16in)



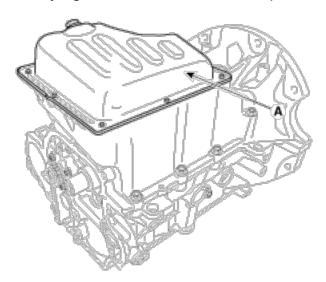
# NOTICE

- Clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant.
- When applying sealant gasket, sealant must not protrude into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.
- (3) Install the lower oil pan (A).

#### **Tightening torque:**

9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

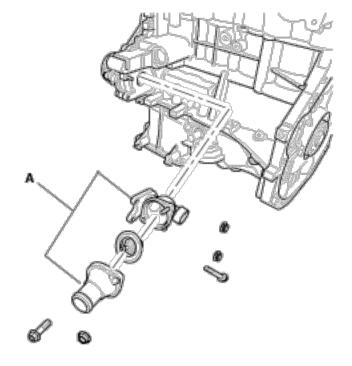
Uniformly tighten the bolts in several passes.



13. Install the water temperature control assembly (A).

## Tightening torque:

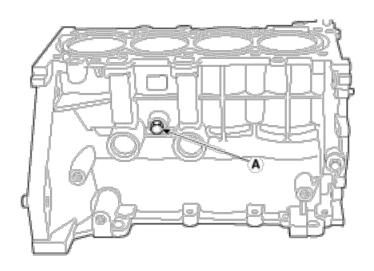
Thermostat housing bolt & nut  $9.8 \sim 11.8 \text{Nm} \ (1.0 \sim 1.2 \text{kgf.m}, 7.2 \sim 8.7 \text{lb-ft})$  Water inlet fitting bolt & nut  $19.6 \sim 26.5 \text{Nm} \ (2.0 \sim 2.7 \text{kgf.m}, 14.5 \sim 19.5 \text{lb-ft})$ 



14. Install the drain plug (A).

### **Tightening torque:**

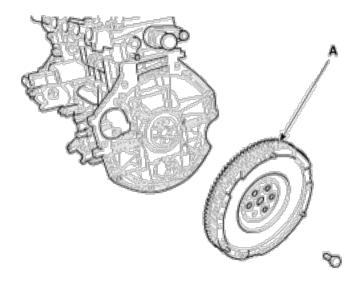
24.5 ~ 29.4Nm (2.5 ~ 3.0kgf.m, 18.1 ~ 21.7lb-ft)



15. Install the flywheel (A).

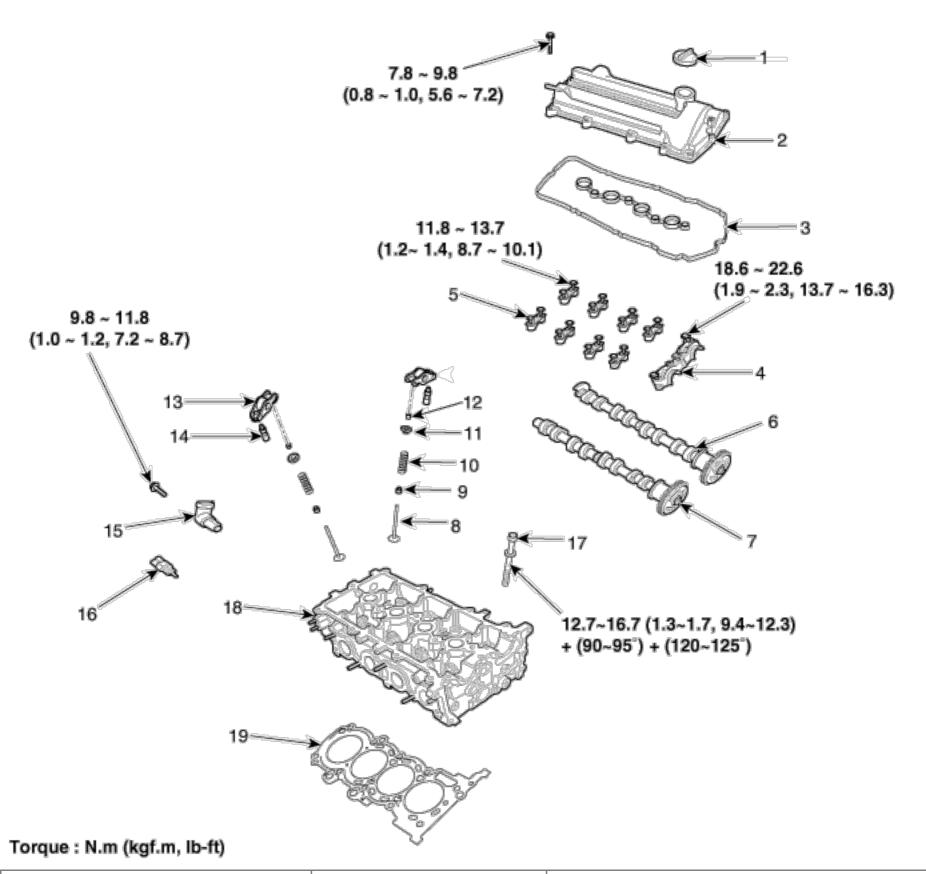
### **Tightening torque:**

68.6 ~ 78.5Nm (7.0 ~ 8.0kgf.m, 50.6 ~ 57.9lb-ft)



- 16. Install the cylinder head. (Refer to Cylinder head in this group)
- 17. Install the timing chain. (Refer to Timing system in this group)
- 18. Install the intake manifold and exhaust manifold. (Refer to Intake and exhaust system in this group)

### **COMPONENTS**



- 1. Oil filler cap
- 2. Cylinder head cover
- 3. Cylinder head cover gasket
- 4. Camshaft bearing cap
- 5. Front camshaft bearing cap
- 6. Intake camshaft assembly
- 7. Exhaust camshaft assembly

- 8. Valve
- 9. Valve stem seal
- 10. Valve spring
- 11. Retainer
- 12. Retainer lock
- 13. Swing arm

- 14. HLA(Hydraulic Lash Adjuster)
- 15. CMP (Camshaft Position) sensor
- 16. ECT (Engine Coolant Temperature) sensor
- 17. Cylinder head bolt
- 18. Cylinder head assembly
- 19. Cylinder head gasket

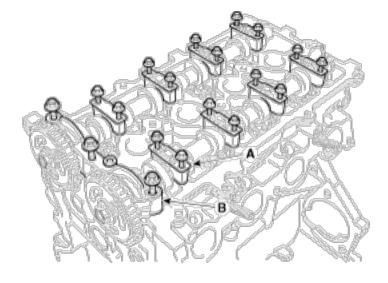
### **REMOVAL**

## **▲** CAUTION

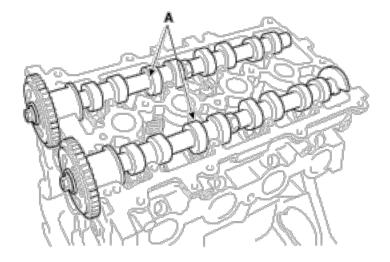
- Use fender covers to avoid damaging painted surfaces
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature (20°C [68°F]) before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

# NOTICE

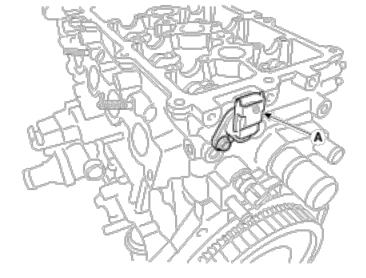
- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.
- 1. Remove the timing chain. (Refer to Timing system in this group)
- 2. Remove the intake and exhaust manifold. (Refer to Intake and exhaust system in this group)
- 3. Remove the camshaft bearing caps (A) and the front camshaft bearing cap (B).



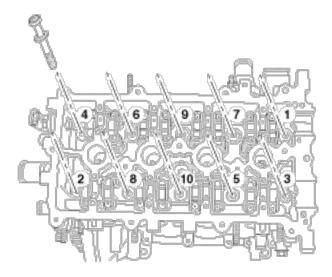
4. Remove the cam shafts (A).



5. Remove the CMP (Camshaft Position) sensor (A).



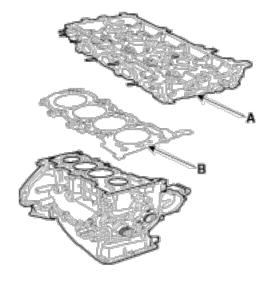
6. Uniformly loosen and remove the cylinder head bolts, in several passes, in the sequence shown.



# NOTICE

Head warpage or cracking could result from removing bolts in an incorrect order.

7. Lift the cylinder head(A) from the dowels on the cylinder block and place the cylinder head on wooden blocks on a bench. And remove the cylinder head gasket (B).

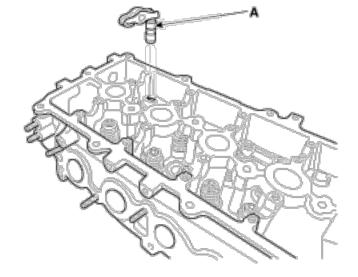


## **NOTICE**

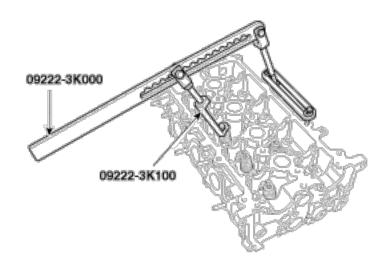
Be careful not to damage the contact surfaces of the cylinder head and cylinder block.

# **DISASSEMBLY**

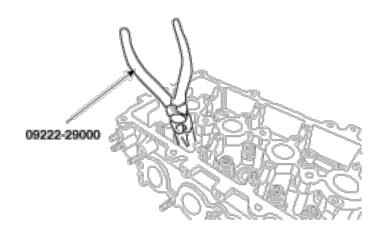
1. Remove the swing arm and the hydraulic lash adjuster assembly (A).



- 2. Remove the valves.
  - (1) Using the SST(09222-3K000, 09222-3K100), press the valve spring and remove retainer lock.



- (2) Remove the spring retainer.
- (3) Remove the valve spring.
- (4) Remove the valve.
- (5) Using the SST(09222-29000), remove the valve stem seal.



# NOTICE

Do not reuse old valve stem seals.

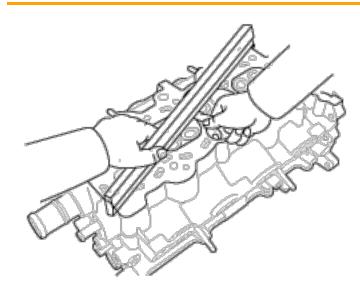
# **INSPECTION**

Inspect for flatness.

Using a precision straight edge and feeler gauge, measure the surface contacting cylinder block and the manifolds for warpage.

Flatness of cylinder head gasket surface

Standard: Less than 0.05mm (0.0020in) Less than 0.02mm (0.0008in) / 100x100 Flatness of manifold gasket surface Standard: Less than 0.1mm (0.0039in)



2. Inspect for cracks.

Check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.

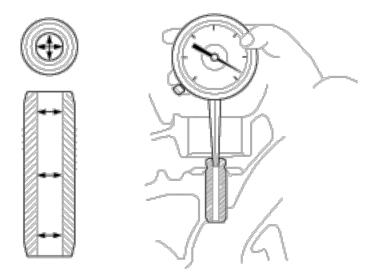
## Valve And Valve Spring

- 1. Inspect valve stems and valve guides.
  - (1) Using a caliper gauge, measure the inside diameter of the valve guide.

### Valve guide I.D.

Intake / Exhaust :

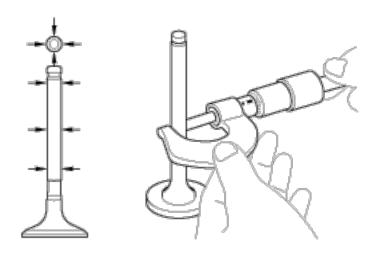
5.500 ~ 5.512mm (0.2165 ~0.2170in)



(2) Using a micrometer, measure the diameter of the valve stem.

#### Valve stem O.D.

Intake: 5.465 ~ 5.480mm ( 0.2151 ~ 0.2157in) Exhaust: 5.458 ~ 5.470mm (0.2148 ~ 0.2153in)



(3) Subtract the valve stem diameter measurement from the valve guide inside diameter measurement.

#### Valve stem-to-guide clearance

Intake: 0.020 ~ 0.047mm (0.00078 ~ 0.00185in) Exhaust: 0.030 ~ 0.054mm (0.00118 ~ 0.00212in)

#### 2. Inspect valves.

(1) Check the valve is ground to the correct valve face angle.

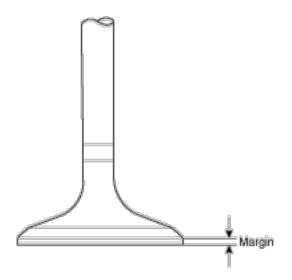
#### Valve face angle:

Intake/Exhaust: 45.25° ~ 45.75°

- (2) Check that the surface of the valve for wear. If the valve face is worn, replace the valve.
- (3) Check the valve head margin thickness. If the margin thickness is less than minimum, replace the valve.

### Margin

Intake: 1.5mm (0.0590in) Exhaust: 1.75mm (0.0688in)



(4) Check the valve length.

### Length

Intake: 100.94mm (3.9740in) Exhaust: 101.09mm (3.9799in)

- (5) Check the surface of the valve stem tip for wear. If the valve stem tip is worn, replace the valve.
- 3. Inspect valve seats.
  - (1) Check the valve seat for evidence of overheating and improper contact with the valve face. If the valve seat is worn, replace cylinder head.
  - (2) Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace cylinder head.
  - (3) Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within

specifications and centered on the valve face.

#### Valve seat contact width:

Intake :  $0.85 \sim 1.15$ mm (  $0.0334 \sim 0.0452$ in) Exhaust :  $1.35 \sim 1.65$ mm ( $0.0531 \sim 0.0649$  in)

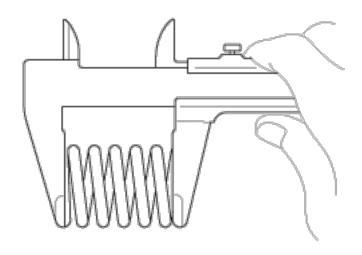
Valve seat angle:

Intake / Exhaust : 44.75° ~ 45.10°

- 4. Inspect valve springs.
  - (1) Using a steel square, measure the out-of-square of the valve spring.
  - (2) Using vernier calipers, measure the free length of the valve spring.

### Valve spring

Free height: 47.9mm (1.8858in) Out-of-square: 1.5° (MAX)



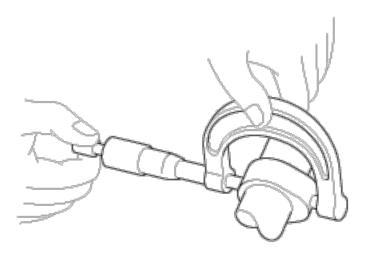
### Camshaft

1. Inspect cam lobes.

Using a micrometer, measure the cam lobe height.

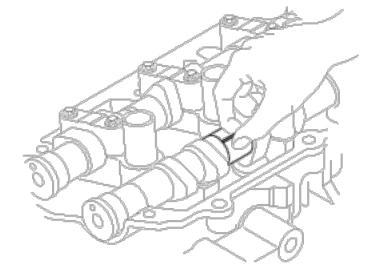
### Cam height (1.2 / 1.25)

Intake: 35.8382mm (1.4109in) / 36.0488mm (1.4192in) Exhaust: 35.7331mm (1.4068in) / 35.7331mm (1.4068in)



If the cam lobe height is less than standard, replace the camshaft.

- 2. Inspect the camshaft journal clearance.
  - (1) Clean the bearing caps and camshaft journals.
  - (2) Place the camshafts on the cylinder head.
  - (3) Lay a strip of plastigage across each of the camshaft journals.

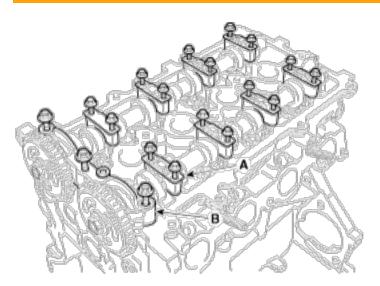


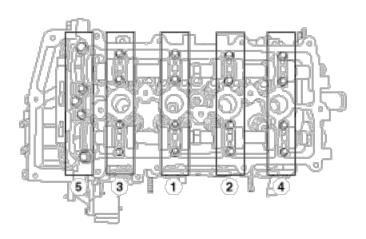
(4) Install the camshaft bearing cap (A) and the front camshaft bearing cap (B) as following method with specified torque.

### **Tightening torque:**

A: 11.8 ~13.7N.m (1.2 ~ 1.4kgf.m, 8.7 ~ 10.1lb-ft)

B: 18.6 ~ 22.6N.m (1.9 ~ 2.3kgf.m, 13.7 ~ 16.6lb-ft)





## NOTICE

Do not turn the camshaft.

- (5) Remove the bearing caps.
- (6) Measure the plastigage at its widest point.

### **Camshaft bearing oil clearance**

Intake: 0.027 ~ 0.057mm (0.0010 ~ 0.0022in) Exhaust: 0.027 ~ 0.057mm (0.0010 ~ 0.0022in)

#### Camshaft journal outer diameter

Intake / Exhaust No.1:

36.464 ~ 36.478mm (1.4356 ~ 1.4361in)

Intake / Exhaust No.2~5:

22.964 ~ 22.978mm (0.9040 ~ 0.9046in)

### Camshaft journal bore inner diameter

Intake / Exhaust No.1:

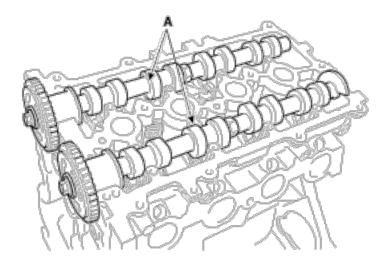
36.505 ~ 36.521mm (1.4372 ~ 1.4378in)

Intake / Exhaust No.2~5:

23.005 ~ 23.021mm (0.9057 ~ 0.9060in)

If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

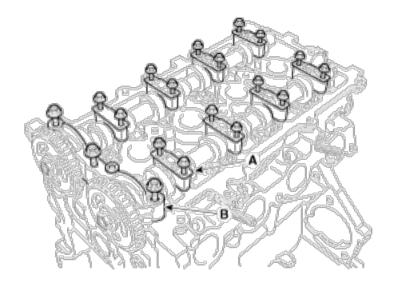
- (7) Completely remove the plastigage.
- (8) Remove the camshafts.
- 3. Inspect the camshaft end play.
  - (1) Install the camshafts (A).

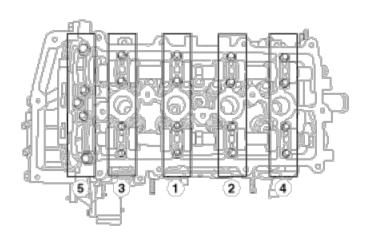


(2) Install the camshaft bearing cap (A) and the front camshaft bearing cap (B) as following method with specified torque.

### **Tightening torque:**

A: 11.8 ~13.7N.m (1.2 ~ 1.4kgf.m, 8.7 ~ 10.1lb-ft) B: 18.6 ~ 22.6N.m (1.9 ~ 2.3kgf.m, 13.7 ~ 16.6lb-ft)





# NOTICE

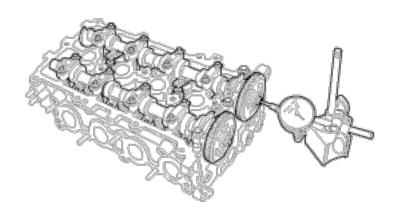
Do not turn the camshaft.

When cam caps are installed, arrows on the top of caps must point to out side of engine.

(3) Using a dial indicator, measure the end play while moving the camshaft back and forth.

### Camshaft end play:

Intake: 0.1 ~ 0.2mm (0.0039 ~ 0.0078in) Exhaust: 0.1 ~ 0.2mm (0.0039 ~ 0.0078in)

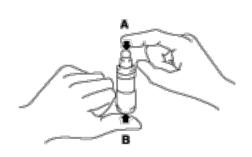


If the end play is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

(4) Remove the camshafts.

# HLA (Hydraulic Lash Adjuster)

With the HLA filled with engine oil, hold A and press B by hand. If B moves, replace the HLA.



Problem	Possible cause	Action
Temporary noise when starting a cold engine	Normal	This noise will disappear after the oil in the engine reaches the normal pressure.
2. Continuous noise when the engine is started after parking more than 48	Oil leakage of the high pressure chamber on the HLA, allowing air to	Noise will disappear within 15 minutes when engine runs at 2000-3000 rpm.lf

hours.	get in.	it doesn't disappear, refer to step 7
3. Continuous noise when the engine is first started after rebuilding cylinder head.	Insufficient oil in cylinder head oil gallery.	below.
4. Continuous noise when the engine is started after excessively cranking the engine by the starter motor or band.	Oil leakage of the high-pressure chamber in the HLA, allowing air to get in.Insufficient oil in the HLA.	
5. Continuous noise when the engine is running after changing the HLA.		Do not run engine at a speed higher than 3000 rpm, as this may damage the HLA.
6. Continuous noise during idle after high engine speed.	Engine oil level too high or too low.	Check oil level.Drain or add oil as necessary.
	Excessive amount of air in the oil at high engine speed.	Check oil supply system.
	Deteriorated oil.	Check oil quality.If deteriorated, replace with specified type.
7. Noise continues for more than 15 minutes.	Low oil pressure.	Check oil pressure and oil supply system of each part of engine.
	Faulty HLA.	Remove the cylinder head cover and press HLA down by hand. If it moves, replace the HLA.
		Be careful with the hot HLAS.

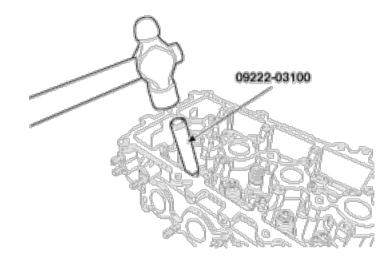
# **REASSEMBLY**

# NOTICE

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- 1. Install the valves.
  - (1) Using the SST(09222-03100), push in a new valve stem seal.

# NOTICE

- Do not reuse old valve stem seals.
- Incorrect installation of the seal could result in oil leakage past the valve guides.

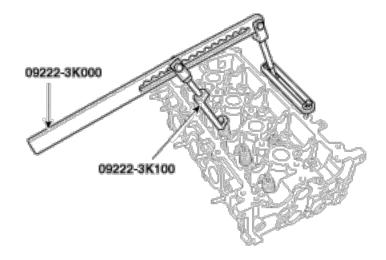


(2) Install the valve, valve spring and spring retainer.

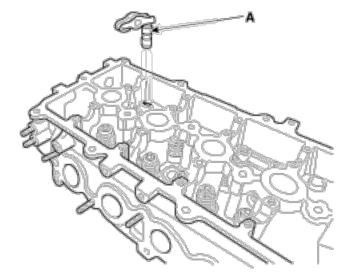
## NOTICE

Place valve springs so that the cone shape side is upward retainer side.

(3) Using the SST(09222 - 3K000, 09222-3K100), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.



- (4) Lightly tap the end of each valve stem two or three times with the wooden handle of a hammer to ensure proper seating of the valve and retainer lock.
- 2. Install the swing arm and the hydraulic lash adjuster assembly (A).

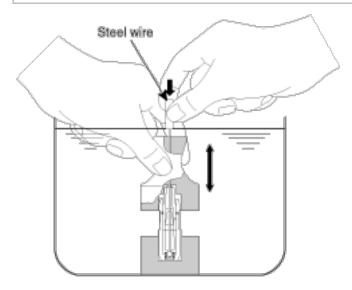


- (1) Until installing HLA shall be held upright so that engine oil in HLA should not spill and assured that dust does not adhere to HLA.
- (2) HLA shall be inserted tenderly to the cylinder head not to spill engine oil from HLA. In case of spilling, air vent shall be done in accordance with the air bent procedure.



Stroke HLA in engine oil 4~5 times by pushing its cap while pushing the ball down slightly by hard steel wire.

(Take care not to severely push hard steel wire down since ball is several grams.)



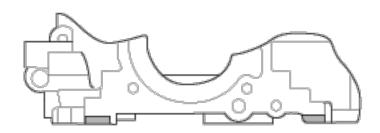
## NOTICE

After installed on engine, lash adjuster might give out unusual noise. If air is mingled then apply slow racing (Approx. one minute for 1 racing) from idle to 3000rpm and is removed from adjuster.

### **INSTALLATION**

### NOTICE

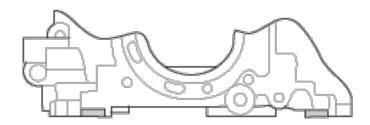
- · Thoroughly clean all parts to be assembled.
- Always use a new head and manifold gasket.
- The cylinder head gasket is a metal gasket. Take care not to bend it.
- Rotate the crankshaft, set the No.1 piston at TDC.
- 1. Install the cylinder head gasket.
  - (1) The sealant locations on cylinder head gasket, cylinder block and timing chain lower case must be free of engine oil and etc.
  - (2) Apply sealant TB1217 or LT5900 on the cylinder block top surface (Refer to below illustration) before assembling the cylinder head gasket.



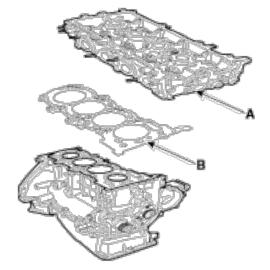
(3) Install the cylinder head gasket on the cylinder block.

Be careful of the installation direction.

(4) Apply sealant TB1217 or LT5900 on the cylinder head gasket top surface (Refer to below illustration) after assembling the cylinder head gasket.



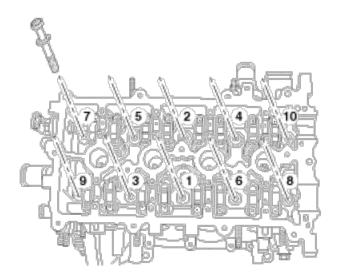
- (5) Remove the extruded sealant after assembling the cylinder head assembly.
- 2. Install the cylinder head assembly.
  - (1) Place the cylinder head assembly (A) quietly in order not to damage the gasket with the bottom part of the end.



(2) Using SST(09221-4A000), tighten the cylinder head bolts and plate washers, in several passes, in the sequence shown.

### **Tightening torque:**

12.7~16.7Nm (1.3~1.7kgf.m, 9.4~12.3lb-ft) + 90~95° + 120~125°



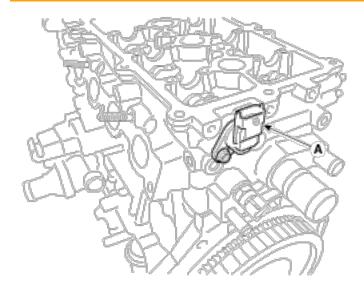
### NOTICE

Do not reuse the cylinder head bolts.

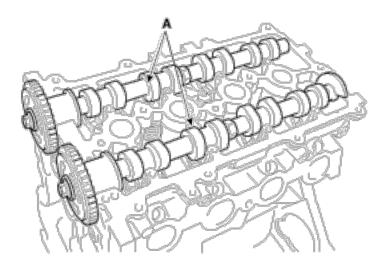
3. Install the CMP (Camshaft Position) sensor (A).

### Tightening torque:

9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



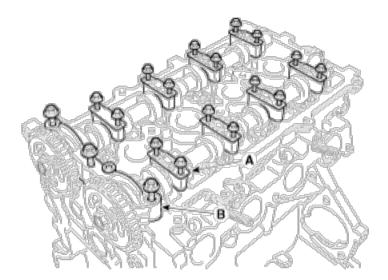
4. Install the cam shafts (A).



5. Install the camshaft bearing cap (A) and the front camshaft bearing cap (B) as following method with specified torque.

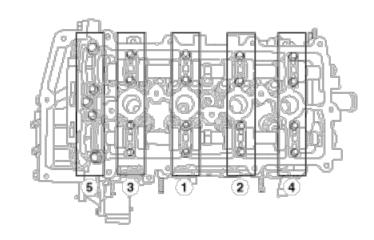
# Tightening torque:

A: 11.8 ~13.7N.m (1.2 ~ 1.4kgf.m, 8.7 ~ 10.1lb-ft) B: 18.6 ~ 22.6N.m (1.9 ~ 2.3kgf.m, 13.7 ~ 16.6lb-ft)



# NOTICE

Arrow on the top of cap must to outside of engine.



- 6. Install the intake and exhaust manifold. (Refer to Intake and exhaust system in this group)
- 7. Install the timing chain. (Refer to Timing system in this group)

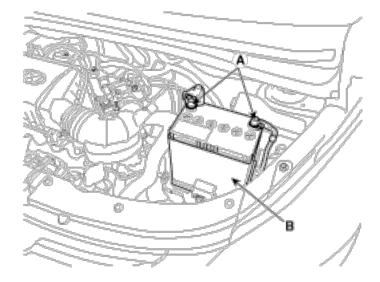
# **REMOVAL**

# **▲** CAUTION

- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

## NOTICE

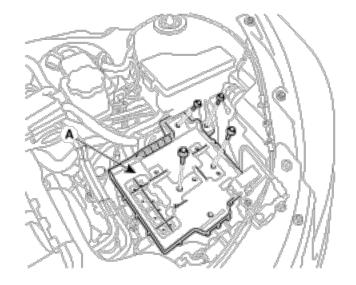
- Mark all wiring and hoses to avoid misconnection.
- 1. Disconnect the battery terminals (A) and remove the battery (B).



2. Remove the battery tray (A).

### Tightening torque:

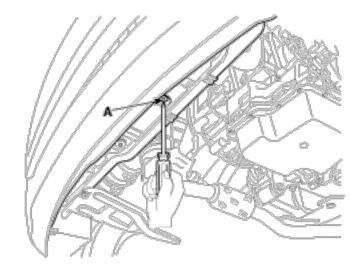
9.8 ~ 11.7N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



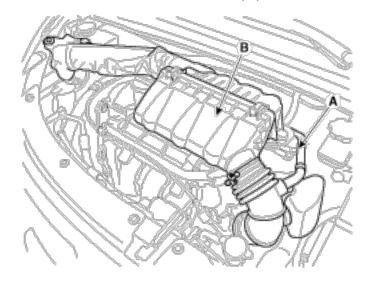
3. Loosen the drain plug (A), and drain the coolant.

# NOTICE

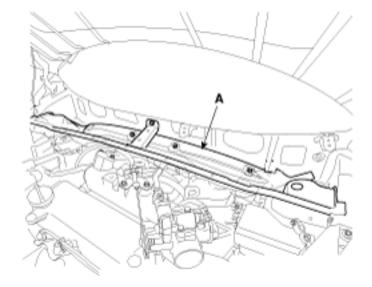
Remove the radiator cap to speed draining.



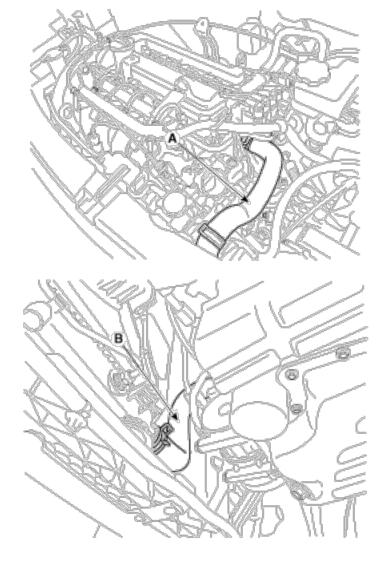
- 4. Recover the refrigerant and remove the high & low pressure pipe. (Refer to Air conditioning system in HA Group.)
- 5. Disconnect the breather hose(A) and Remove the air cleaner assembly (B).



- 6. Remove the cowl grill and wiper motor. (Refer to Wiper motor in BD group.)
- 7. Remove the cowl panel (A).



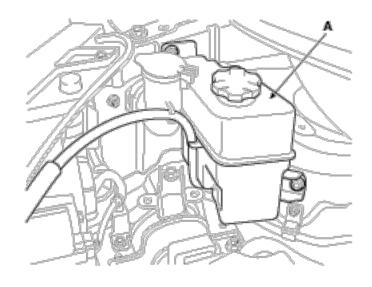
8. Remove the radiator upper hose (A), lower hose (B) and reservoir hose.



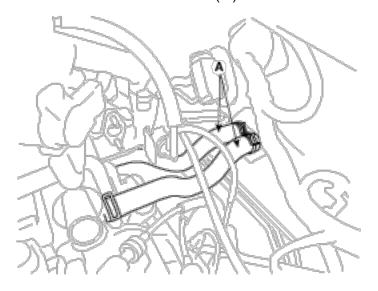
9. Remove the reservoir tank (A).

# Tightening torque:

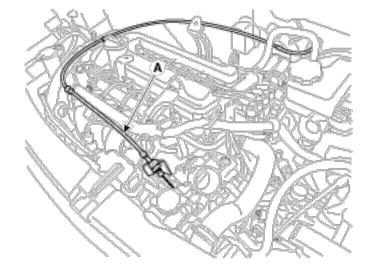
6.9 ~ 10.8Nm (0.7 ~ 1.1kgf.m, 5.1 ~ 7.9lb-ft)



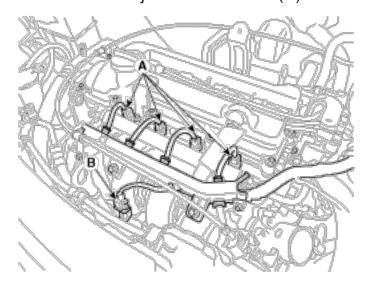
10. Remove the heater hoses (A).



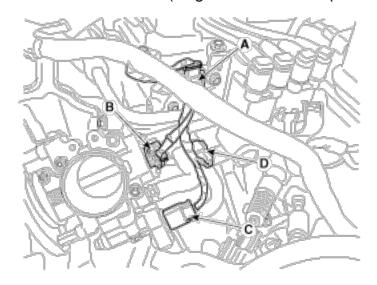
- 11. Remove the engine wire harness connectors and wire harness clamps from engine.
  - (1) Remove the accelerator cable (A).



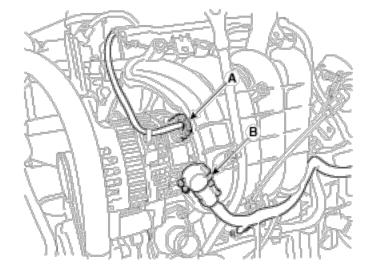
(2) Disconnect the injector connectors (A) and the knock sensor connector (B).



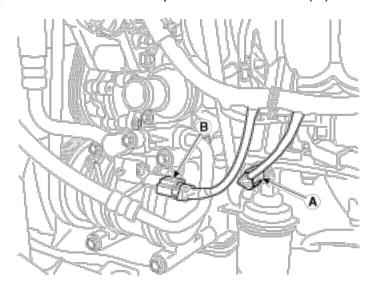
- (3) Disconnect the CMP (Camshaft position sensor) connector (A).
- (4) Disconnect the ISA (Idle Speed Actuator) connector (B).
- (5) Disconnect the TPS (Throttle Position Sensor) connector (C).
- (6) Disconnect the ECT (Engine Coolant Temperature) sensor connector (D).



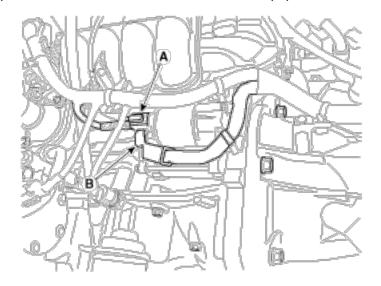
(7) Disconnect the alternator connector (A) and B terminal cable (B).



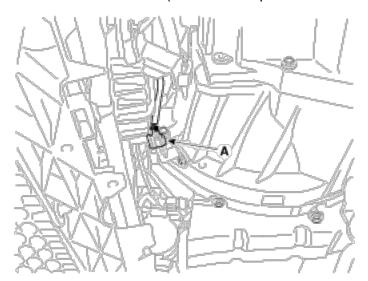
- (8) Disconnect the OPS (Oil Pressure Switch) connector (A).
- (9) Disconnect the compressor connector (B).



(10) Disconnect the starter connector (A) and B terminal cable (B).

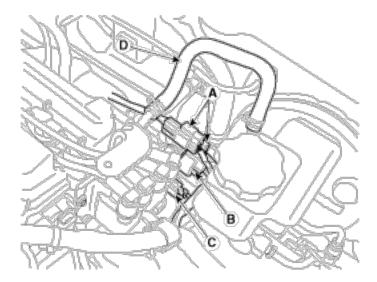


(11) Disconnect the CKP (Crankshaft position sensor) connector (A).



(12) Disconnect the oxygen sensor connectors (A).

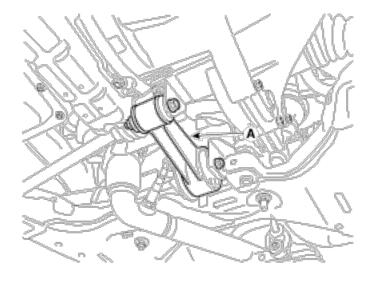
- (13) Disconnect the ignition coil connector (B).
- (14) Disconnect the PCSV (Purge Control Solenoid Valve) connector (C) and PCSV hose.
- (15) Disconnect the brake booster vacuum hose (D).
- (16) Disconnect the fuel hose.



- 12. Remove the transaxle wire harness connectors and control cable from the transaxle. (Refer to AT or MT group).
- 13. Remove the drive shafts. (Refer to Drive shaft In DS group)
- 14. Remove the stabilizer bar link. (Refer to SS group)
- 15. Remove the rear roll stopper (A).

### **Tightening torque:**

49.0 ~ 63.7Nm (5.0 ~ 6.5kgf.m, 36.1 ~ 47.0lb-ft)



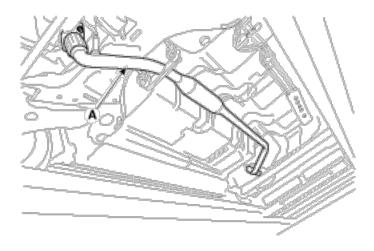
### NOTICE

Mark the rear roll stopper direction for proper installation.

16. Remove the front muffler (A).

### **Tightening torque:**

39.2 ~ 53.9Nm(4.0 ~ 5.5kgf.m, 28.9 ~ 39.8lb-ft)



17. Using a floor jack, support the engine and transaxle assembly.

### **▲** CAUTION

After removing the mounting bolt (engine and transaxle), the engine and transaxle assembly may fall downward, and so support them securely with floor jack.

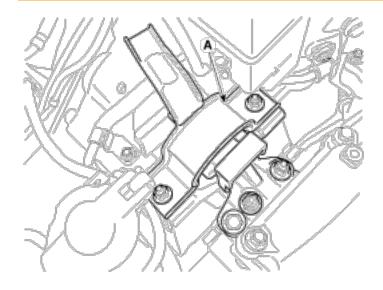
Verify that the hoses and connectors are disconnected before removing the engine and transaxle assembly.

18. Remove the engine mounting bracket (A).

### **Tightening torque**

Bolts and nuts:

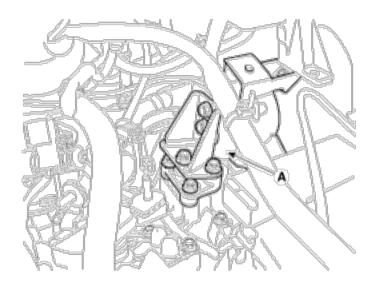
49.0 ~ 63.7Nm (5.0 ~ 6.5kgf.m, 36.1 ~ 47.0lb-ft)



19. Remove the transaxle mounting bracket (A).

#### **Tightening torque:**

49.0 ~ 63.7Nm (5.0 ~ 6.5kgf.m, 36.1 ~ 47.0lb-ft)



20. Remove the engine and transaxle assembly by lifting vehicle.



When remove the engine and transaxle assembly, be careful not to damage any surrounding parts or body components.

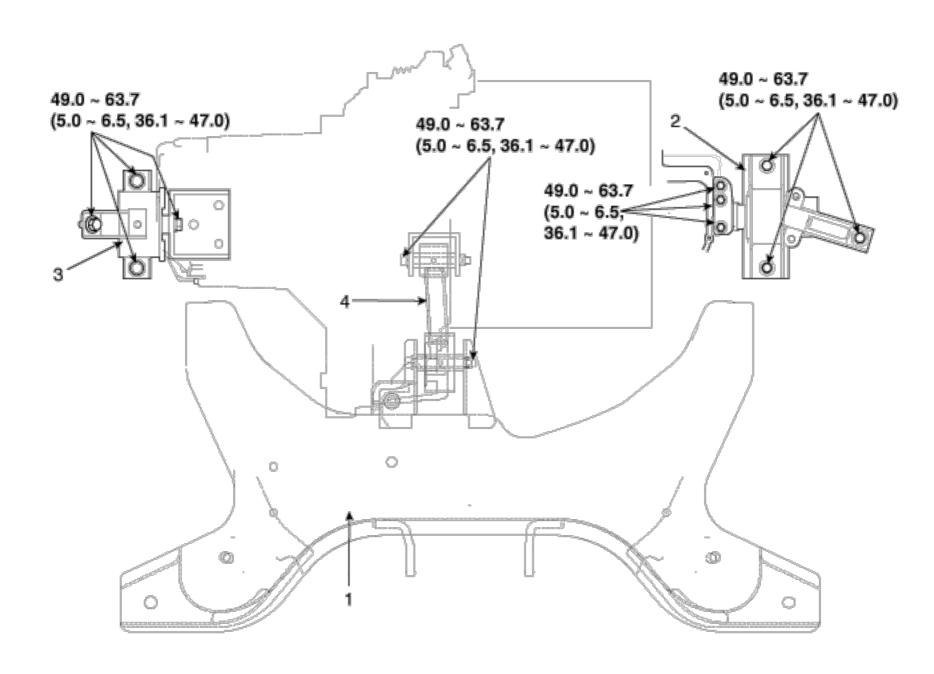
#### **INSTALLATION**

Installation is in the reverse order of removal.

Perform the following:

- Adjust the shift cable.
- Adjust the throttle cable.
- Refill engine with engine oil.
- · Refill transaxle with fluid.
- Clean the battery posts and cable terminals with sandpaper assemble them, then apply grease to prevent corrosion.
- Inspect for fuel leakage.
- After assembling the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.
- Repeat this operation two or three times, then check for fuel leakage at any point in the fuel lines.
- Refill radiator with engine coolant.
- Bleed air from the cooling system.
- Start engine and let it run until it warms up. (Until the radiator fan operates 3 or 4 times.)
- Turn Off the engine. Check the level in the radiator, add coolant if needed. This will allow trapped air to be removed from the cooling system.
- Put radiator cap on tightly, then run the engine again and check for leaks.

### **COMPONENTS**



### Torque: N.m (kgf.m, lb-ft)

1. I TOTIL CLOSS ITICITISCI	1.	Front	cross	membe	۲
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2. Engine mounting bracket

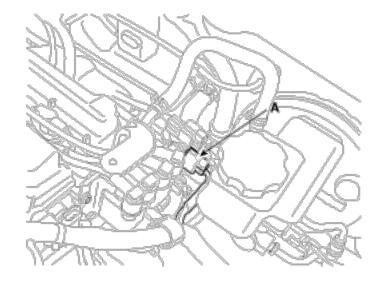
- 3. Transaxle mounting bracket
- 4. Rear roll stopper

#### **COMPRESSION PRESSURE INSPECTION**

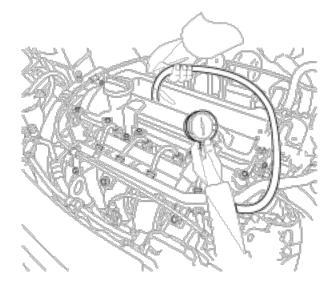
### NOTICE

If there is lack of power, excessive oil consumption or poor fuel economy, measure te compression pressure.

- 1. Start the engine and allow to warm up to operating temperature (about five minutes). Stop the engine.
- 2. Disconnect the ignition coil connector (A) and thespark plug cables.



- 3. Remove the four spark plugs using a 16mm sparkplug wrench.
- 4. Check the cylinder compression pressure.
  - (1) Insert a compression gauge into the spark plughole.



- (2) Fully open throttle.
- (3) While cranking the engine, measure the compression pressure.

### NOTICE

Always use a fully charged battery to obtain engine speed of 250 rpm or more.

(4) Repeat step (1) through (3) for each cylinder.

### NOTICE

This measurement must be done in as short atime as possible

### **Compression pressure:**

1,667kPa (17.0kg/cm<sup>2</sup>, 241psi)

### Minimum pressure:

1,470kPa (15.0kg/cm², 213psi)

#### Difference between each cylinder:

98kPa (1.0kg/cm², 14psi) or less

- (5) If the cylinder compression in 1 or more cylindersis low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeatstep (1) through (3) for cylinders with lowcompression.
  - If adding oil helps the compression, it is likelythat the piston rings and/or cylinder bore areworn or damaged.
  - If pressure stays low, a valve may be stickingor seating is improper, or there may beleakage past the gasket.
- 5. Reinstall the spark plugs.

#### Tightening torque:

14.7 ~ 24.5N.m (1.5 ~ 2.5kgf.m, 10.8 ~ 18.1lb-ft)

6. Connect the ignition coil connector and the sparkplug cables.

### **SPECIAL SERVICE TOOLS**

(09222-3K100)

SPECIAL SERVICE TOOLS						
Tool (Number and name)	Illustration	Use				
Drive belt remover & installer (09252-03100)		Removal and installation of the full option type drive belt. Removal of the non-A/C type drive belt.				
Drive belt installer (Non-A/C type) (09252-03200)		Installation of the non-A/C type drive belt				
Flywheel stopper (09231-2B100)		Removal and installation of the flywheel and crankshaft pulley				
Torque angle adapter (09221-4A000)		Installation of bolts & nuts needing an angular method				
Valve stem seal remover (09222-29000)		Removal of the valve stem seal				
Valve stem seal installer (09222-03100)		Installation of the valve stem seal				
Valve spring compressor & holder (09222-3K000)		Removal and installation of the intake or exhaust valves				

A: 09222-3K000

B: 09222-3K100 (holder)

n of the crankshaft rear oil seal
of oil pan

Limit

**Description** 

### **SPECIFICATIONS**

General

Type

Number of cylinders		4		
Bore		71.0mm (2.7952in)		
Stroke		75.6mm (2.9763in)	78.8mm (3.1023in)	
Total displacement		1.197cc (72.7cu.in)	1.248cc (76.2cu.in)	
Compression ratio		10.5 : 1		
Firing order		1-3-4-	2	
Valve timing				
Intake valve	Opens (BTDC)	12°	12°	
	Closes (ABDC)	33°	37°	
Exhaust valve	Opens (BBDC)	41°	41°	
Closes (ATDC)		6°	6°	
Cylinder head				
Flatness of gasket surface		Less than 0.05mm (0.0020in) Less than 0.02mm (0.0008in) / 100x100		
Flatness of manifold	Intake	Less than 0.1mm (0.0039in)		
mounting surface	Exhaust	Less than 0.1mm (0.0039in)		
Camshaft				
Camheight	Intake	35.8382mm (1.4109in)	36.0489mm (1.4192in)	
	Exhaust	35.7331mm (1.4068in)	35.7331mm (1.4068in)	

**KAPPA 1.2** 

**Specification** 

In-line, DOHC

**KAPPA 1.25** 

# Stem outer diameter

Face angle

Thickness of

Valve stem to

valve head (margin)

valve guide clearance

Valve length

Valve

	Intake
	Exhaust
er	Intake

Exhaust

Intake

Intake

Exhaust

Intake/Exhaust

No.2~5

Journal outer Diameter Intake/Exhaust No.1

100.94mm (3.9740in)

101.09mm (3.9799in) 5.465 ~ 5.480mm (0.2151 ~ 0.2157in)

1.50mm (0.0590in)

1.75mm (0.0688in)

 $0.020 \sim 0.047$ in  $(0.00078 \sim 0.00185$ in)

22.964 ~ 22.978mm (0.9040 ~ 0.9046in)

5.458 ~ 5.470mm (0.2148 ~ 0.2153in)

)	
)	

(1.4068in) 36.464 ~ 36.478mm (1.4355 ~ 1.4361in)

	Exhaust	0.030 ~ 0.054in (0.00118 ~ 0.00212in)				
Valve spring	Valve spring					
Free length		47.9mm (1.8858in)				
Load		16.7±0.8kg/35.5mm (164±8N/1.3976in)				
		29.6±1.0kg/27.7mm (290±10N/1.0905in)				
Out of squareness		1.5° MAX				
Cylinder block						
Cylinder bore		71.00~71.03 mm (2.7952 ~2.7964in)				
Flatness of gasket surfa	ice	Less than 0.05mm (0.0020in) Less than 0.02mm (0.0008in) / 100x100				
Piston						
Piston outer diameter		70.97~71.00 mm(2.7952~2.7940in)				
Piston to cylinder cleara	ince	0.02 ~ 0.04mm (0.0008 ~ 0.0016in)				
Ring groove width	No. 1 ring groove	1.03 ~ 1.05mm (0.0405 ~ 0.0413in)				
	No. 2 ring groove	1.23 ~ 1.25mm (0.0484 ~ 0.0492in)				
	Oil ring groove	2.01 ~ 2.03mm (0.0791 ~ 0.0799in)				
Piston ring						
Side clearance	No. 1 ring	0.04 ~ 0.08mm (0.0015 ~ 0.0031in)				
	No. 2 ring	0.04 ~ 0.08mm (0.0015 ~ 0.0031in)				
	Oil ring	0.04 ~ 0.12mm (0.0015 ~ 0.0047in)				
End gap	No. 1 ring	0.13 ~ 0.25mm (0.0051 ~ 0.0048in)				
	No. 2 ring	0.30 ~ 0.45mm (0.0118 ~ 0.0177in)				
	Oil ring	0.1 ~ 0.4mm (0.0039 ~ 0.0157in)				
Piston pin						
Piston pin outer diamete	er	18.000 ~ 18.003mm (0.7086 ~ 0.7087in)				
Piston pin hole inner dia	ameter	18.013 ~ 18.017mm (0.7092 ~ 0.7093in)				
Piston pin hole clearance	e	0.010 ~ 0.017mm (0.00039 ~ 0.00067in)				
Connecting rod small er	nd hole inner diameter	17.974 ~ 17.985mm (0.7076 ~ 0.7474in)				
Connecting rod small er	nd hole clearance	-0.015 ~ -0.029mm (0.00059 ~ 0.00114in)				
Piston pin press-in load		300 ~ 1300kg (661 ~ 2866lb)				
Connecting rod						
Connecting rod big end	inner diameter	42.000 ~ 42.018mm (1.6535~1.6542in)				
Connecting rod bearing oil clearance		0.018 ~ 0.036 mm (0.0007 ~ 0.0014in)				
Side clearance		0.1 ~ 0.25 mm (0.0039 ~ 0.0098in)				
Crankshaft						
Main journal outer diameter		42.942 ~ 42.960mm (1.6906~1.6913in)				
Pin journal outer diameter		38.954 ~ 38.972mm (1.5336~1.5343in)				
Main bearing oil clearance		0.006 ~ 0.024mm (0.0002~0.0009in)				
End play		0.07 ~ 0.25mm (0.0027~0.0098in)				
Oil pump						
Side clearance Inner rotor		0.040 ~ 0.090m (0.0016 ~ 0.0035in)				

	Outer rotor	0.180 ~ 0.258mm (0.0071 ~ 0.0102in)			
Relief spring	Free length	58.3mm (2.2952in)			
	Load	3.5bar ± 0.5			
Engine oil					
Oil quantity	Total	3.5	3.55 L (3.74 US qt, 3.12 lmp qt)		When replacing a short engine or a block assembly
	Oil pan	3.3	3 L (3.48 US qt, 2.90	Imp qt)	
	Drain and refill	3.6	6 L (3.80 US qt, 3.17	Imp qt)	Including oil filter
Oil grade	Recommendation (except Middle East)	5W-20/GF4&SM		If not available, refer to the recommended API or ILSAC classification and SAE viscosity number.	
	Classification	I	API SL, SM or abo LSAC GF3, GF4 or a		Satisfy the requirement of the API classification.
	SAE viscosity grade	Recommended SAE viscosity number		Refer to the "Lubrication System"	
Oil pressure (at 680rpm)		83kPa (0.85kg/cm², 12.0psi) or above		Oil temperature in oil pan : 95±5°C (203± 41°F)	
Cooling method					
Cooling system		Forc	ed circulation with w	ater pump	
Thermostat Type			Wax pellet type	!	
	Opening temperature	8	32 ± 1.5 °C (179.6 ± 2	2.7°F)	
	Full opening temperature	95°C (203°F)			
Radiator cap	Main valve opening pressure	(0.95	93.16 ~ 122.58kp ~ 1.25kg/cm², 13.51		
	Vacuum valve opening pressure	(0.01	0.98 ~ 4.90 kPa ~ 0.05kg/cm², 0.14		
Water temperature se	ensor				
Туре		Thermistor type			
Resistance	20°C (68°F)		2.45±0.14 kΩ		
	80°C (176°F)	0.3222 kΩ			
Tightening Torque	es				
It	em	Quantity	N.m	kgf.m	lb-ft
Cylinder block					
Ladder frame bolt		10	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
Engine mounting					
Engine mounting brac	ket and body fixing blot	3	49.0 ~ 63.7	5.0 ~ 6.5	36.1 ~ 47.0
Engine mounting bracket and engine support bracket fixing bolt		1	49.0 ~ 63.7	5.0 ~ 6.5	36.1 ~ 47.0

Engine mounting bracket and engine support bracket fixing nut	2	49.0 ~ 63.7	5.0 ~ 6.5	36.1 ~ 47.0
Transaxle mounting bracket and body fixing bolt	3	49.0 ~ 63.7	5.0 ~ 6.5	36.1 ~ 47.0
Transaxle mounting insulator and transaxle support bracket fixing bolt	2	49.0 ~ 63.7	5.0 ~ 6.5	36.1 ~ 47.0
Rear roll stopper bracket and sub frame fixing bolt	1	49.0 ~ 63.7	5.0 ~ 6.5	36.1 ~ 47.0
Rear roll stopper bracket and rear roll stopper support bracket bolt	1	49.0 ~ 63.7	5.0 ~ 6.5	36.1 ~ 47.0
Main moving system				
Connecting rod bearing cap bolt	8	(10.8~14.7) + (88~92°)	(1.1~1.5) + (88~92°)	(8.0~10.8) + (88~92°)
Crankshaft main bearing cap bolt	10.	(17.7~21.6) + (88~92°)	(1.8~2.2) + (88~92°)	(13.0~15.9) + (88~92°)
Fly wheel bolt (M/T)	6	68.6 ~ 78.5	7.0 ~ 8.0	50.6 ~ 57.9
Drive plate bolt (A/T)	6	68.6 ~ 78.5	7.0 ~ 8.0	50.6 ~ 57.9
Timing chain				
Timing chain cover bolt (A)	5	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Timing chain cover bolt (B)	3	44.1 ~ 53.9	4.5 ~ 5.5	32.5 ~ 39.8
Timing chain cover bolt (C)	8	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain cover bolt (D)	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Crankshaft pulley bolt	1	127.5 ~ 137.3	13.0 ~ 14.0	94.0 ~ 101.3
Camshaft sprocket bolt	2	63.7 ~ 73.5	6.5 ~ 7.5	47.0 ~ 54.2
Timing chain tensioner bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain cam guide bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain crank guide bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain tensioner arm bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain guide bolt	2	18.6 ~ 21.6	1.9 ~ 2.2	13.7 ~ 15.9
Cylinder head				
Cylinder head cover bolt	16	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Camshaft bearing cap bolt	16	11.8 ~ 13.7	1.2 ~ 1.4	8.7 ~ 10.1
Camshaft front bearing cap bolt	3	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.5
Cylinder head bolt	10	(12.7~16.7) + (90~95°) + (120~125°)	(1.3~1.7) + (90~95°) + (120~125°)	(9.4~12.3) + (90~95°) + (120~125°)
Cooling system				
Water pump pulley bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump bolt	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Heater pipe bolt (6×55)	2	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Thermostat housing bolt & nut	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water inlet fitting bolt & nut	3	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Lubrication system				

Oil filter	1	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6
Oil pump	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan bolt	10	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan drain plug	1	34.3 ~ 44.1	3.5 ~ 4.5	25.2 ~ 32.4
Oil screen nut	2	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil pressure switch	1	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Intake and exhaust system				
Intake manifold bolt & nut	5	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Exhaust manifold stay	3	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Exhaust manifold heat protector	3	8.8 ~ 10.8	0.9 ~ 1.1	6.5 ~ 7.9
Throttle body fixing bolt and nut	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Exhaust manifold nut	5	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Front muffler pipe and main muffler pipe clamp nut	1	17.7 ~ 27.5	1.8 ~ 2.8	13.0 ~ 20.3

Suspect area

Loose or damaged engine drive plate.

Worn crankshaft bearings.

Remedy

Replace the crankshaft and bearings

as required.

Replace the valve lifters.

sprockets.

Replace the timing chain and

## **TROUBLESHOOTING**

lower engine noises.

**Symptom** 

Engine misfire with abnormal internal

<b>G</b>		Repair or replace the drive plate as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression.Repair or replace as required.
	Worn crankshaft thrust bearings	Replace the crankshaft and bearings as required.
Engine misfire with abnormal valve train noise.	Stuck valves. (Carbon buildup on the valve stem)	Repair or replace as required.
	Excessive worn or mis-aligned timing chain.	Replace the timing chain and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and valve lifters.
	HLA sponge	Run the engine at 2500~3000rpm within 15 minutes.  If it dosen't disappear, refer to cylinder head assembly in this group.
Engine misfire with coolant consumption.	<ul> <li>Faulty cylinder head gasket and/or cranking or other damage to the cylinder head and engine block cooling system.</li> </ul>	Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket.
	Coolant consumption may or may not cause the engine to overheat.	Repair or replace as required.
Engine misfire with excessive oil consumption.	Worn valves, guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not	Inspect the cylinder for a loss of compression.
	cause the engine to misfire)	Repair or replace as required.
Engine noise on start-up, but only	Incorrect oil viscosity.	Drain the oil.
lasting a few seconds.		Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	Inspect the thrust bearing and crankshaft.
		Repair or replace as required.
Upper engine noise, regardless of	Low oil pressure.	Repair or replace as required.
engine speed.	Broken valve spring.	Replace the valve spring.

Worn or dirty valve lifters.

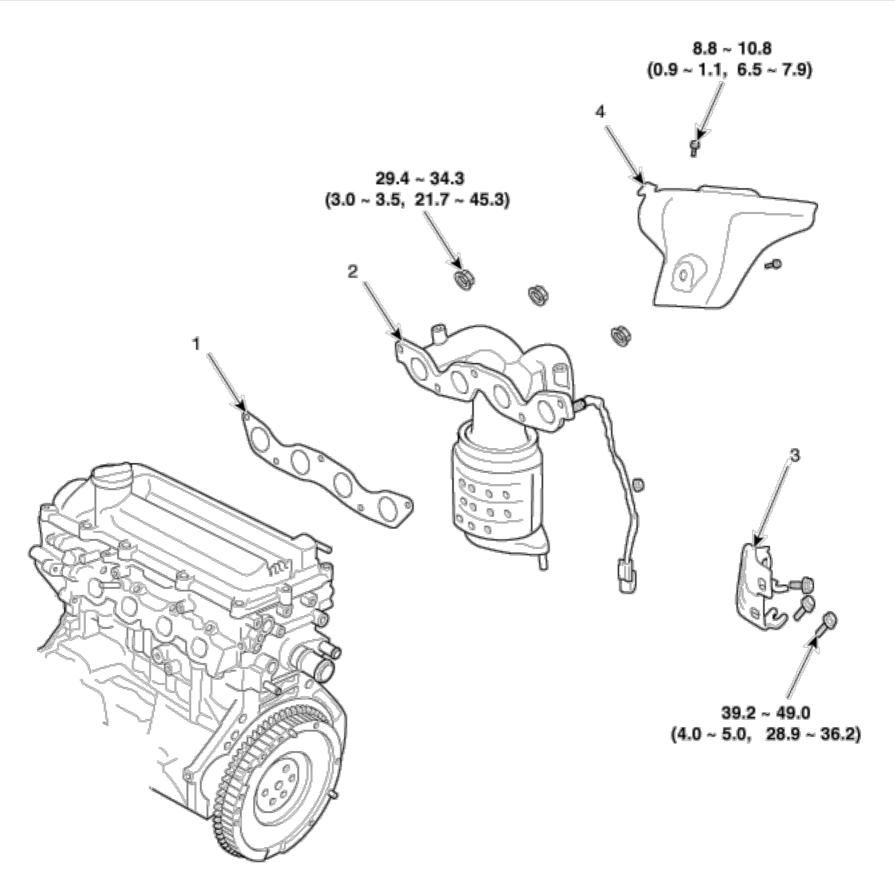
Stretched or broken timing chain

and/or damaged sprocket teeth.

	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	Inspect the camshaft lobes.
		Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves.Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the valves and valve guides, then repair as required.
	Worn drive belt, idler, tensioner and bearing.	Replace as required.
Lower engine noise, regardless of	Low oil pressure.	Repair as required.
engine speed.	Loose or damaged drive plate.	Repair or replace the drive plate.
	Damaged oil pan, contacting the oil pump screen.	<ul><li>Inspect the oil pan.</li><li>Inspect the oil pump screen.</li><li>Repair or replace as required.</li></ul>
	Oil pump screen loose, damaged or restricted.	<ul><li>Inspect the oil pump screen.</li><li>Repair or replace as required.</li></ul>
	Excessive piston-to-cylinder bore clearance.	<ul><li>Inspect the piston, piston pin and cylinder bore.</li><li>Repair as required.</li></ul>
	Excessive piston pin-to-piston clearance.	<ul> <li>Inspect the piston, piston pin and the connecting rod.</li> <li>Repair or replace as required.</li> </ul>
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required.  • The connecting rod bearings.  • The connecting rods.  • The crankshaft pin journals.
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required.  • The crankshaft bearings.  • The crankshaft main journals.  • The cylinder block.
	Incorrect piston, piston pin and connecting rod installation	<ul> <li>Verify the piston pins and connecting rods are installed correctly.</li> <li>Repair as required.</li> </ul>
Engine noise under load	Low oil pressure	Repair or replace as required.
Engine noise under load.	Low oil pressure  Excessive connecting rod bearing clearance.	Inspect the following components and repair as required :

		<ul><li>The connecting rod bearings.</li><li>The connecting rods.</li><li>The crankshaft.</li></ul>
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required.  • The crankshaft bearings.  • The crankshaft main journals.  • The cylinder block.
Engine will not crank-crankshaft will not rotate.	Hydraulically locked cylinder.  • Coolant/antifreeze in cylinder.  • Oil in cylinder.  • Fuel in cylinder.	<ul> <li>Remove spark plugs and check for fluid.</li> <li>Inspect for broken head gasket.</li> <li>Inspect for cracked engine block or cylinder head.</li> <li>Inspect for a sticking fuel injector and/or leaking fuel regulator.</li> </ul>
	Broken timing chain and/or timing chain and/or timing chain gears.	<ul><li>Inspect timing chain and gears.</li><li>Repair as required.</li></ul>
	Material in cylinder.  • Broken valve  • Piston material  • Foreign material	<ul> <li>Inspect cylinder for damaged components and/or foreign materials.</li> <li>Repair or replace as required.</li> </ul>
	Seized crankshaft or connecting rod bearings.	<ul><li>Inspect crankshaft and connecting rod bearing.</li><li>Repair as required.</li></ul>
	Bent or broken connecting rod.	<ul><li>Inspect connecting rods.</li><li>Repair as required.</li></ul>
	Broken crankshaft.	<ul><li>Inspect crankshaft.</li><li>Repair as required.</li></ul>

### **COMPONENTS**



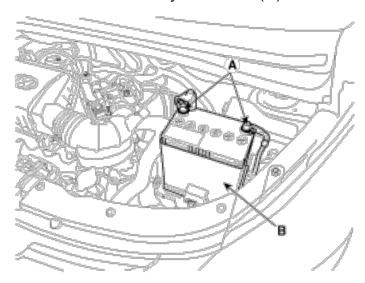
Torque: N.m (kgf.m, lb-ft)

- 1. Exhaust manifold gasket
- 2. Exhaust manifold assembly

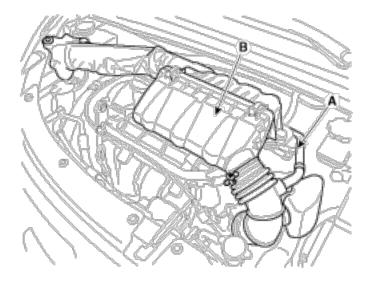
- 3. Exhaust manifold stay
- 4. Heat protector

## **REMOVAL**

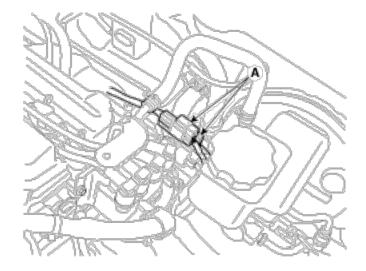
1. Disconnect the battery terminals (A).



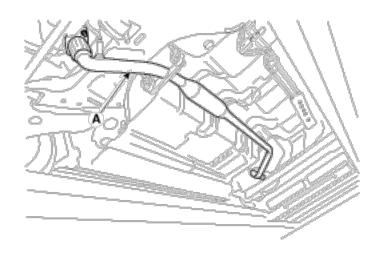
2. Disconnect the breather hose(A) and Remove the air cleaner assembly (B).



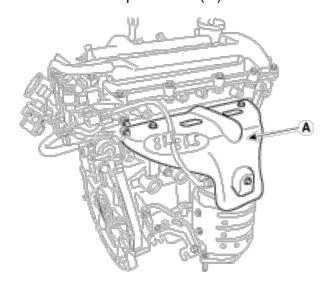
3. Disconnect the oxygen sensor connectors (A).



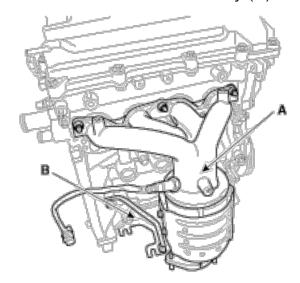
4. Removal the front muffler (A).



5. Remove the heat protector (A).



6. Remove the exhaust manifold stay (B) and exhaust manifold assembly (A).



## **INSTALLATION**

1. Install the exhaust manifold assembly (A) and exhaust manifold stay (B).

### **Tightening torque**

**Exhaust manifold nuts:** 

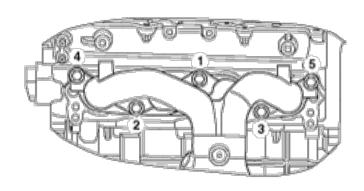
29.4 ~ 34.3Nm (3.0 ~ 3.5kgf.m, 21.7 ~ 25.3lb-ft)

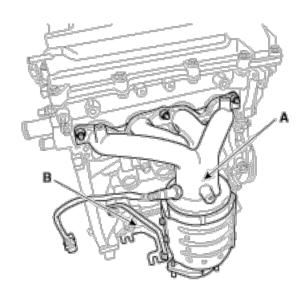
Stay bolts:

39.2 ~ 49.0Nm (4.0 ~ 5.0kgf.m, 28.9 ~ 36.2lb-ft)

### NOTICE

Tighten the nuts as following method.

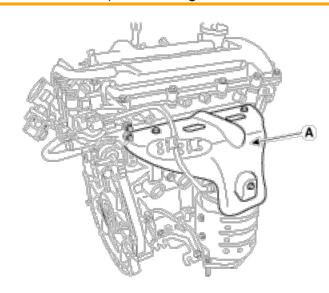




2. Install the heat protector (A).

### Tightening torque:

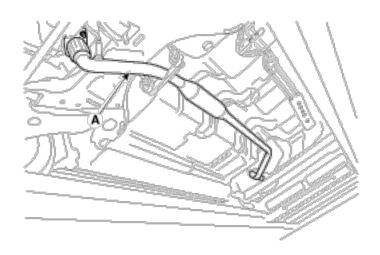
8.8 ~ 10.8Nm (0.9 ~ 1.1kgf.m, 6.5 ~ 7.9lb-ft)



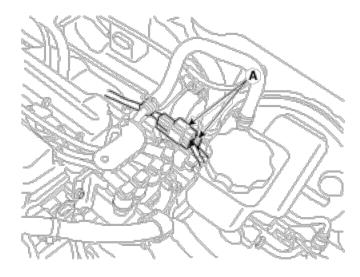
3. Install the front muffler (A).

## Tightening torque :

39.2 ~ 53.9Nm (4.0 ~ 5.5kgf.m, 28.9 ~ 39.8lb-ft)



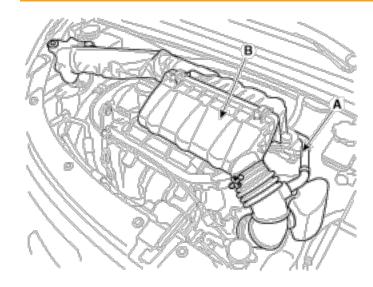
4. Connect the oxygen sensor connectors (A).



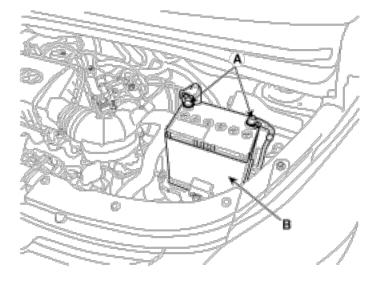
5. Install the air cleaner assembly (B) and connect the breather hose (A).

### Tightening torque:

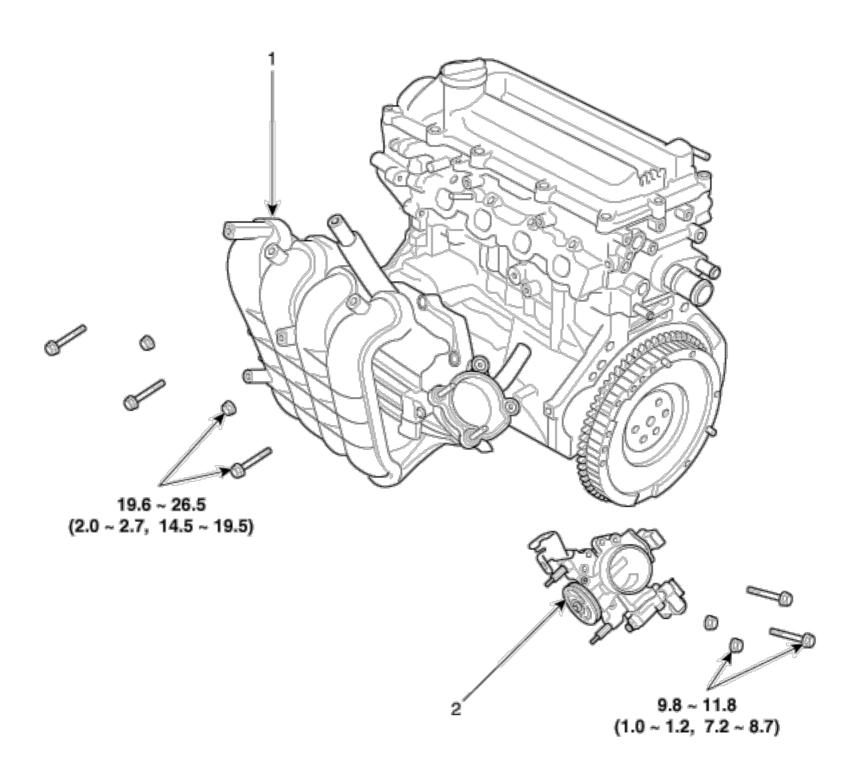
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



6. Connect the battery terminals (A).



### **COMPONENTS**



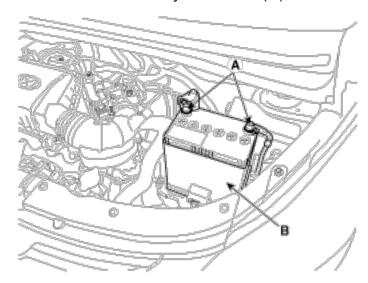
Torque: N.m (kgf.m, lb-ft)

1. Intake manifold

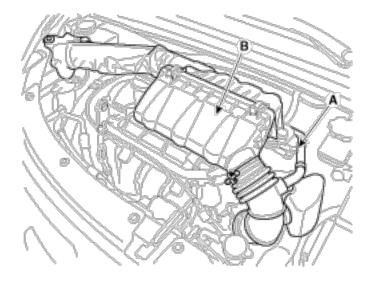
2. Throttle body

### **REMOVAL**

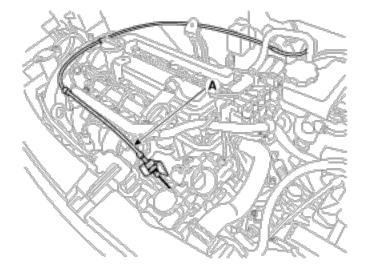
1. Disconnect the battery terminals (A).



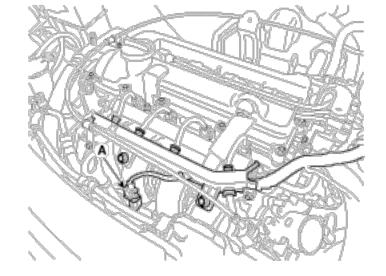
2. Disconnect the breather hose(A) and Remove the air cleaner assembly (B).



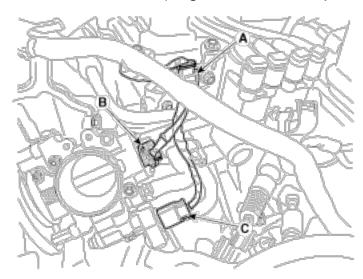
3. Disconnect the accelerator cable (A) from the throttle body.



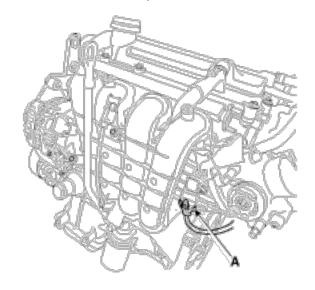
4. Disconnect the knock sensor connector (A) and loosen the wire harness protector mounting bolts.



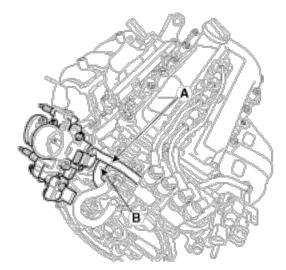
- 5. Disconnect the ISA (Idle Speed Actuator) connector (A).
- 6. Disconnect the TPS (Throttle Position Sensor) connector (B).
- 7. Disconnect the ECT (Engine Coolant Temperature) sensor connector (C).



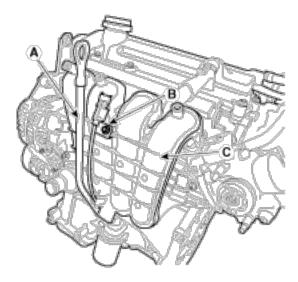
8. Disconnect the MAP (Manifold Absolute Pressure) sensor connector (A).



9. Remove the coolant hose (A) and vacuum hose.



10. Remove the oil level gauge (A), knock sensor bracket (B) and then remove the intake manifold assembly (C).



### **INSTALLATION**

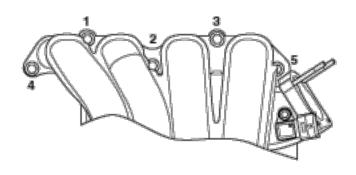
1. Install the intake manifold assembly (C).

### **Tightening torque:**

19.6 ~ 26.5N.m (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)

### NOTICE

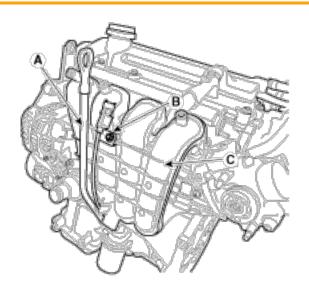
Tighten the bolts and nuts as following method.



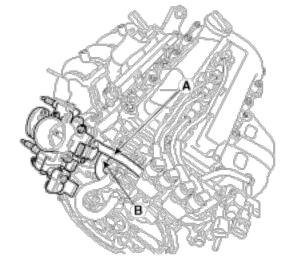
2. Install the oil level gauge (A), knock sensor bracket (B).

### **Tightening torque:**

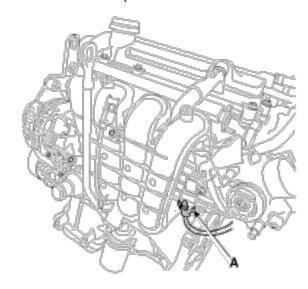
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



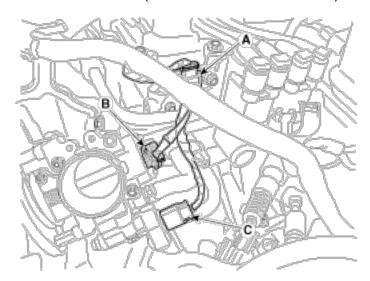
3. Connect the coolant hose (A) and vacuum hose (B).



4. Connect the MAP (Manifold Absolute Pressure) sensor connector (A).



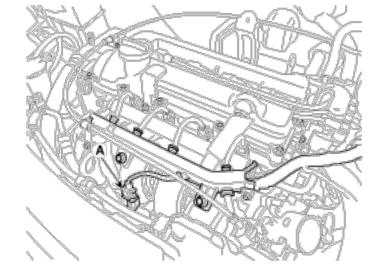
- 5. Connect the ECT (Engine Coolant Temperature) sensor connector (C).
- 6. Connect the ISA (Idle Speed Actuator) connector(B).
- 7. Connect the TPS (Throttle Position Sensor) connector (A).



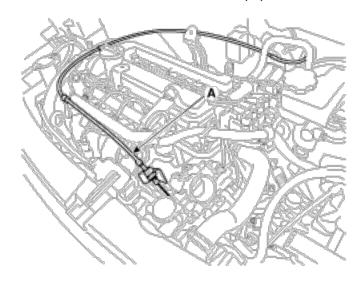
8. Connect the knock sensor connector (A) and tighten the wire harness protector mounting bolts.

### **Tightening torque:**

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



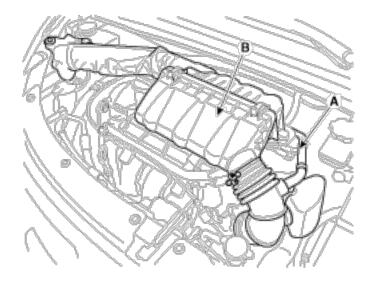
9. Connect the accelerator cable (A) from the throttle body.



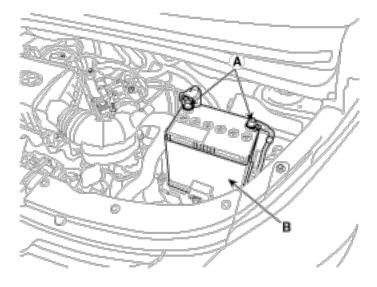
10. Install the air cleaner assembly (B) and connect the breather hose (A).

### Tightening torque :

9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



11. Connect the battery terminals (A).

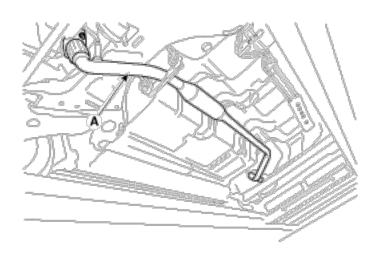


#### REPLACEMENT

1. Remove the front muffler (A).

### **Tightening torque:**

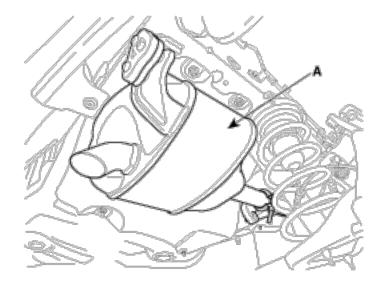
39.2 ~ 53.9Nm (4.0 ~ 5.5kgf.m, 28.9 ~ 39.8lb-ft)



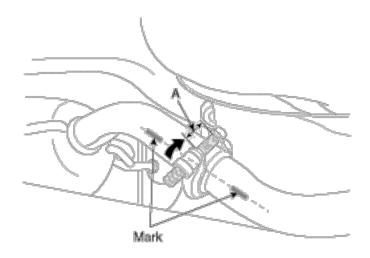
2. Remove the main muffler.

#### Tightening torque:

39.2 ~ 53.9Nm (4.0 ~ 5.5kgf.m, 28.9 ~ 39.8lb-ft)



- 3. Installation is in the reverse order of removal with new gasket.
- 4. Install the clamp in between the front muffler pipe and main muffler pipe.
  - (1) Align the marks on the front muffler pipe and main muffler pipe as shown illustration.



(2) The clamp installing position (A) must be upper than the line virtually made by the two marks.

**Tightening torque :** 17.7~ 27.5Nm (1.8 ~ 2.8kgf.m, 13.0 ~ 20.3lb-ft)

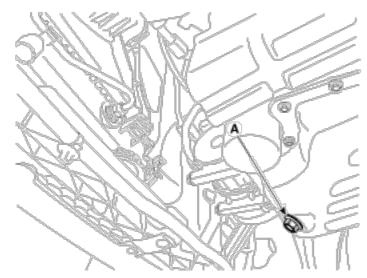


Do not reuse the clamp.

#### **ENGINE OIL AND FILTER REPLACEMENT**

### **▲** CAUTION

- Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.
- Exercise caution in order to minimize the length and frequency of contact of your skin to used oil. Wear protective clothing and gloves. Wash your skin thoroughly with soap and water, or use water-less hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.
- In order to preserve the environment, used oil and used oil filter must be disposed of only at designated disposal sites.
- 1. Drain the engine oil.
  - (1) Remove the oil filler cap.
  - (2) Remove the oil drain plug (A) and drain the oil into a container.



(3) Clean and install the oil drain plug with a new gasket.

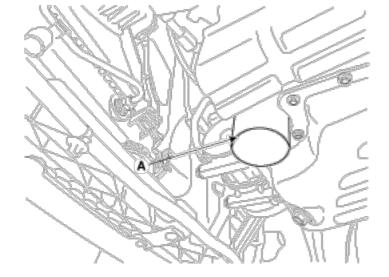
#### **Tightening torque:**

34.3 ~ 44.1Nm (3.5 ~ 4.5kgf.m, 25.3 ~ 32.5lb-ft)

- 2. Replace the oil filter.
  - (1) Remove the oil filter.
  - (2) Check and clean the oil filter installation surface.
  - (3) Check the part number of the new oil filter is as same as old one.
  - (4) Apply clean engine oil to the gasket of a new oil filter.
  - (5) Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.
  - (6) Tighten it with the torque below.

#### Tightening torque:

11.8 ~ 15.7N.m (1.2 ~ 1.6kgf.m, 8.7 ~ 11.6lb-ft)



3. Fill with new engine oil, after removing the engine oil level gauge.

#### Oil capacity

Total: 3.55 L (3.74 US qt, 3.12 lmp qt) Oil pan: 3.3 L (3.48 US qt, 2.90 lmp qt)

Drain and refill including oil filter: 3.6L (3.80S qt, 3.17lmp qt)

- 4. Install the oil filler cap.
- 5. Start engine and check for oil leaks.
- 6. Recheck the engine oil level.

### **INSPECTION**

1. Check the engine oil quality.

Check for oil deterioration, entry of water, discoloring of thinning.

If the quality is visibly poor, replace the oil.

2. Check the engine oil level.

After warming up the engine for five minutes, stop the engine and check the oil level. The level should be between the "L" and "F" marks on the dipstick.

If low, check for oil leakage and add oil up to the "F" mark on the dipstick.

### Selection Of Engine Oil

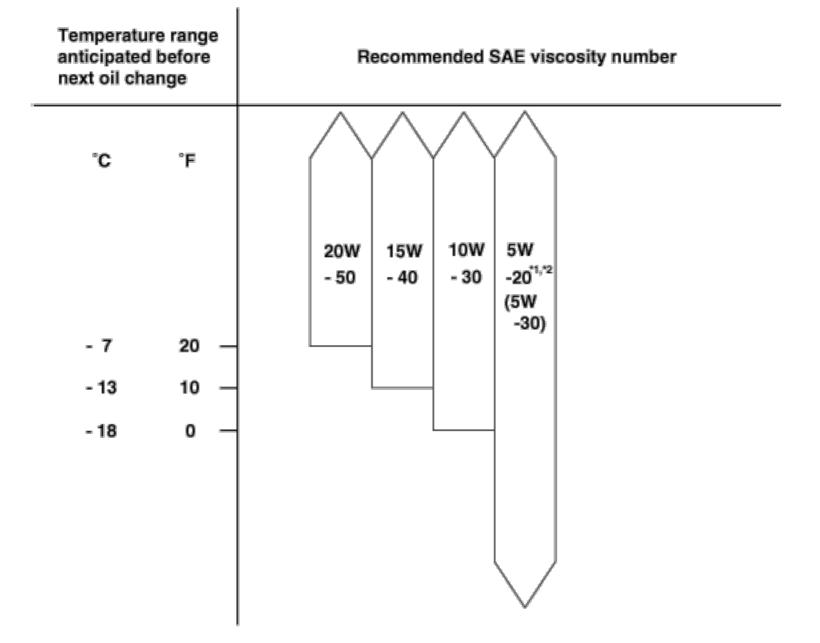
Recommendation (except Middle East): 5W-20/GF4&SM (If not available, refer to the recommended API or ILSAC classification

and SAE viscosity number.)

API classification : SL, SM or above

ILSAC classification: GF3, GF4 or above

SAE viscosity grade: Refer to the recommended SAE viscosity number.



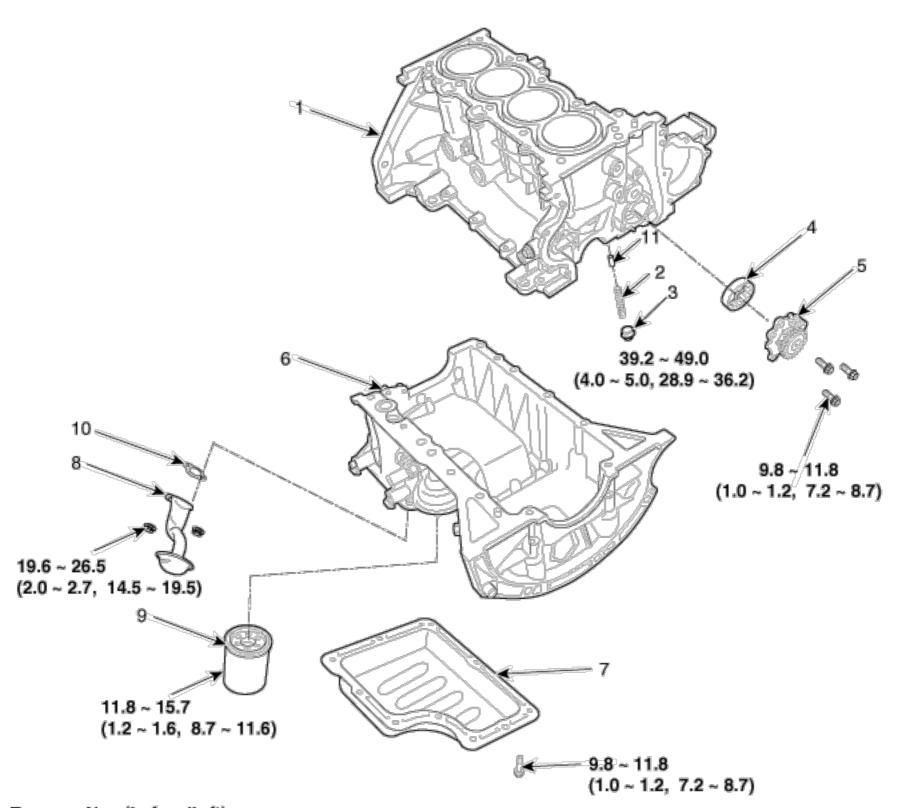
- \*1 If 5W-20 / GF4 engine oil is not available, 5W-30 or secondary recommended engine oil for corresponding temperature range can be used.
- \*2 In Middle East, do not use the engine oil of viscosity grade SAE 5W-20.

### NOTICE

For best performance and maximum protection of all types of operation, select only those lubricants which:

- 1) Satisfy the requirement of the API or ILSAC classification.
- 2) Have proper SAE grade number for expected ambient temperature range.
- 3) Lubricants that do not have both an SAE grade number and API or ILSAC service classification on the container should not be used.

### **COMPONENTS**

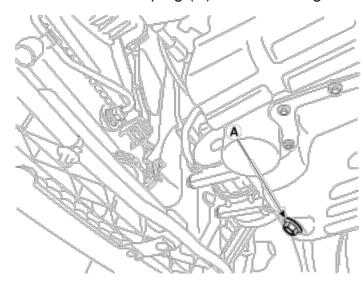


Torque: N.m (kgf.m, lb-ft)

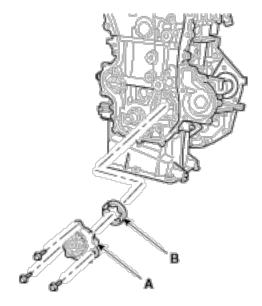
1. Cylinder block	5. Oil pump	9. Oil filter
2. Relief spring	6. Ladder frame	10. Gasket
3. Relief plug	7. Oil pan	11. Relief plunger
4. Outer rotor	8. Oil screen	

### **REMOVAL**

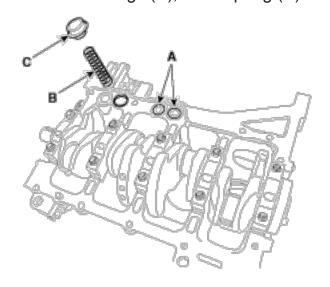
1. Remove the drain plug (A) and drain engine oil.



- 2. Remove the timing chain. (Refer to Timing system in this group)
- 3. Remove the oil pump (A) and outer rotor (B) from the cylinder block.



- 4. Remove the ladder frame. (Refer to Cylinder block in this group)
- 5. Remove the O-rings (A), relief spring (B) and the relief valve (C).



Inspect the relief plunger.
 Coat the plunger with engine oil and check that it falls smoothly into the plunger hole by its own weight.

2. Inspect the relief valve spring.

Inspect for distorted or broken relief valve spring.

#### Standard value

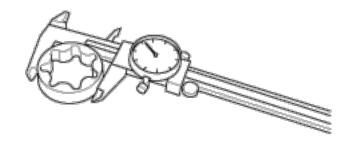
Free height: 46.6mm (1.8346in)

Load:

16.7±0.8kg / 34.7mm (164±8N / 1.3661in) 29.6±1.0kg / 26.9mm (290±10N / 1.0590in)

- 3. Inspect the rotor side clearance.
  - (1) Using a vernier calipers measure the diameter of outer rotor.

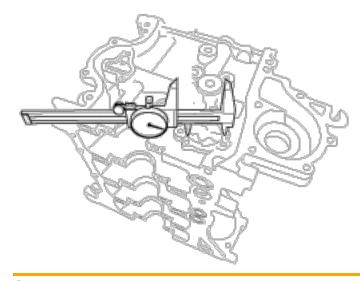
If it does not, replace the relief plunger. If necessary, replace the front case.



#### Standard diameter

46.781 ~ 46.820mm (1.8417 ~ 1.8433in)

(2) Using a vernier calipers measure the diameter of cylinder block oil pump hole.



#### Standard diameter

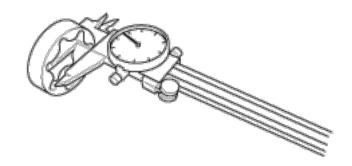
47.000 ~ 47.039mm (1.8503 ~ 1.8519in)

(3) Calculate the difference between the outer rotor and the cylinder block hole.

### Standard clearance:

0.180 ~ 0.258mm (0.0071 ~0.0102in)

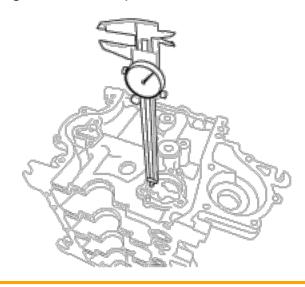
- 4. Inspect the rotor width clearance.
  - (1) Using a vernier calipers measure the width of outer rotor.



#### **Standard width**

12.96 ~ 12.98 mm (0.5102~ 0.5110in)

(2) Using a vernier calipers measure the diameter of cylinder block oil pump hole.



#### Standard width

13.02 ~ 13.05mm (0.5125 ~ 0.5137in)

(3) Calculate the difference between the outer lotor and the cylinder block hole.

#### **Standard clearance:**

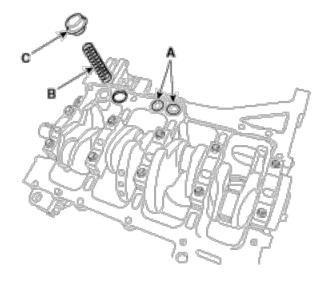
 $0.040 \sim 0.090 \text{ mm} (0.0015 \sim 0.0035 \text{in})$ 

### **INSTALLATION**

1. Install the O-rings (A) and relief spring (B) the relief valve (C).

#### **Tightening torque:**

39.2 ~ 49.0Nm (4.0 ~ 5.0kgf.m, 28.9 ~ 36.2lb-ft)



- 2. Install the ladder frame. (Refer to Cylinder block in this group)
- 3. Install the outer rotor (B) and the oil pump (A).

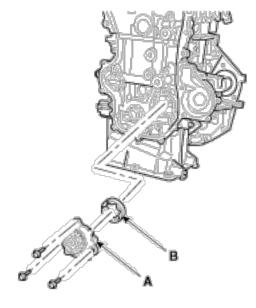
### Tightening torque:

9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft) -8EA

# NOTICE

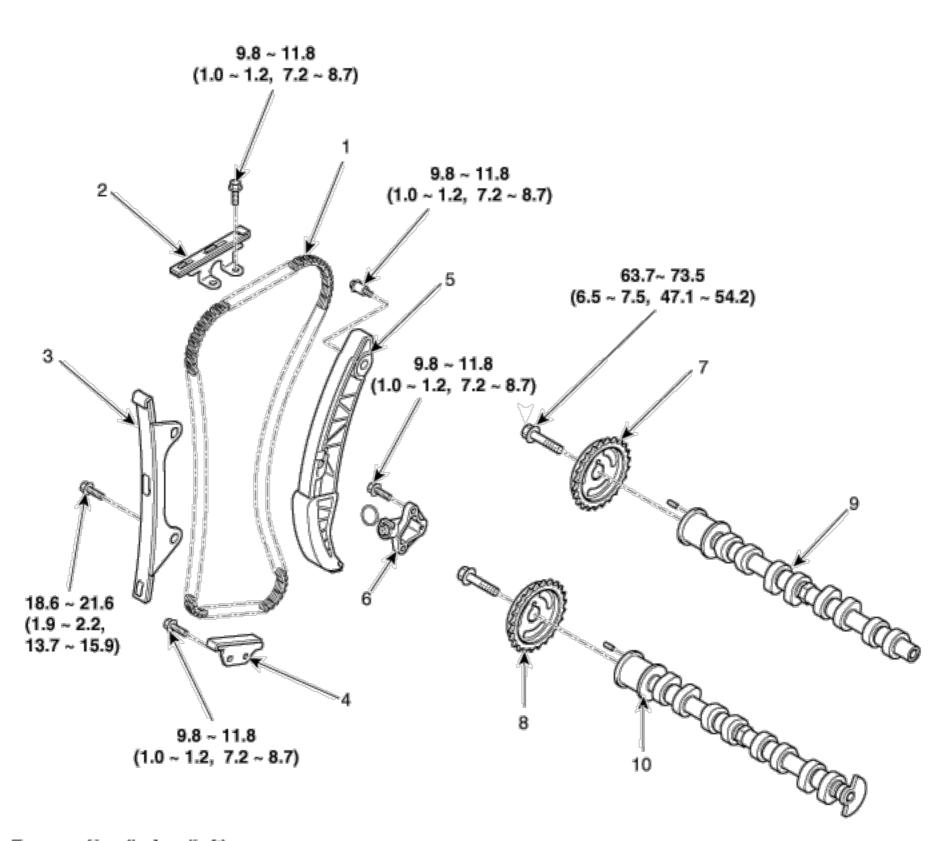
Apply engine oil when rotor assemble.

4. Install the oil pump to true position of dowel pin & cover reamer hole when pump install.



- 5. Install the timing chain. (Refer to Timing system in this group)
- 6. Refill the engine oil.

### **COMPONENTS**



Torque : N.m (kgf.m, lb-ft)

- 1. Timing chain
- 2. Timing chain cam guide
- 3. Timing chain guide
- 4. Timing chain crank guide
- 5. Timing chain tensioner arm
- 6. Timing chain tensioner
- 7. Exhaust camshaft sprocket
- 8. Intake camshaft sprocket
- 9. Exhaust camshaft
- 10. Intake camshaft

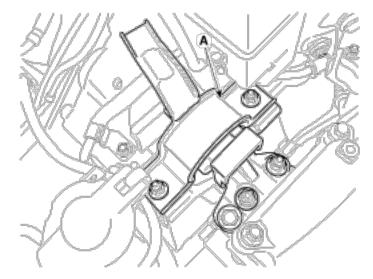
#### **REMOVAL**

# **▲** CAUTION

- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

# NOTICE

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No.1 piston is at top dead center.
- 1. Remove the engine mounting bracket (A).

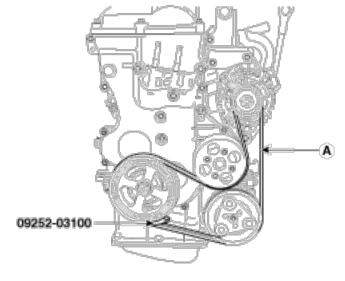


# NOTICE

- Set a jack to support the engine before the mounting bracket is removed.
- Place a rubber block between the jack and oil pan.
- 2. Remove the drive belt (A).

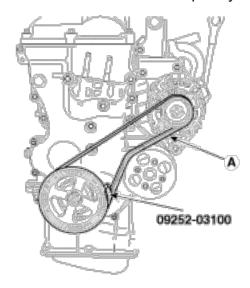
# [Full-option type]

- (1) Insert the SST(09252-03100) between the crankshaft pulley and the drive belt.
- (2) Rotate 2 revolutions of crankshaft pulley into clockwise direction. And then remove the drive belt.

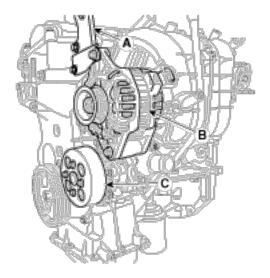


# [Non- A/C type]

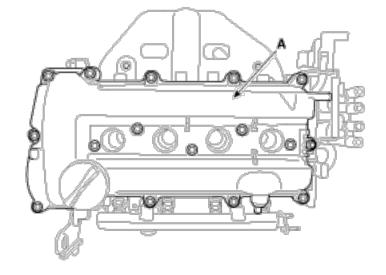
- (3) Insert the SST(09252-03100) between the crankshaft pulley and the drive belt.
- (4) Rotate 2 revolutions of crankshaft pulley into clockwise direction. And then remove the drive belt.



3. Remove the alternator bracket (A), alternator (B) and water pump pulley (C).



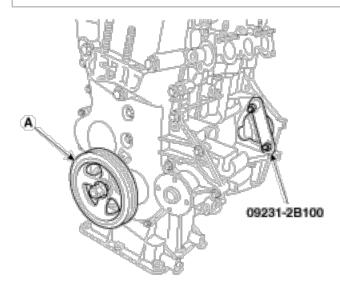
4. Remove the cylinder head cover (A).



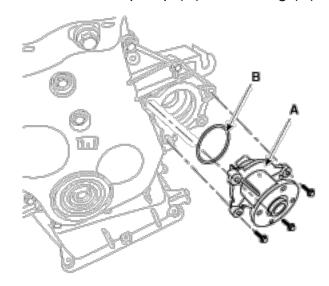
5. Remove the crankshaft pulley (A).

### **NOTICE**

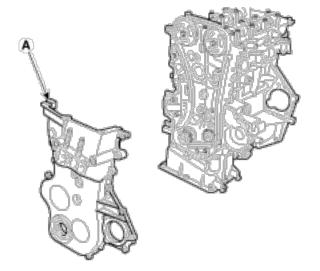
Use the SST (flywheel stopper, 09231-2B100) to remove the crankshaft pulley bolt, after remove the starter.



6. Remove the water pump (A) and O-ring (B).



7. Remove the timing chain cover (A).

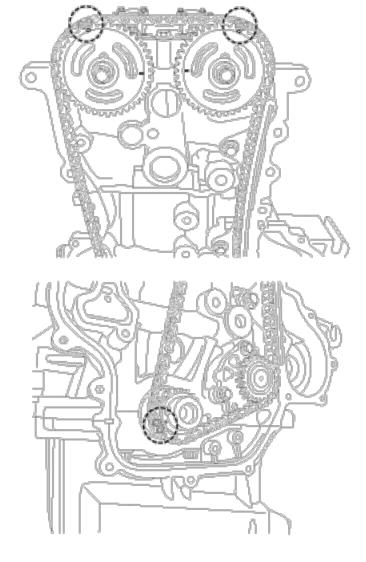


# **▲** CAUTION

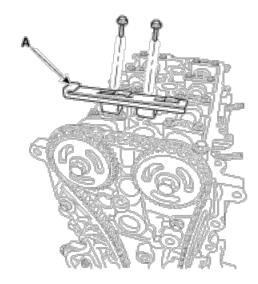
Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover.

# NOTICE

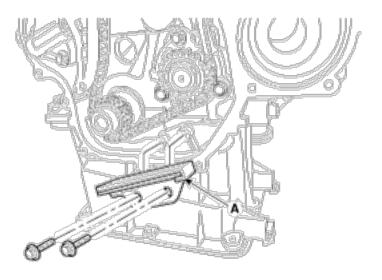
Before removing the timing chain, mark the timing chain with an identification based on the location of the sprocket because the identification mark on the chain for TDC (Top Dead Center) can be erased.



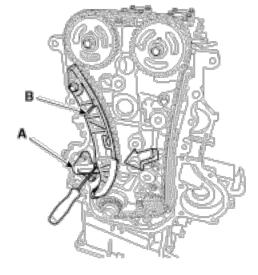
8. Remove the timing chain cam guide (A).



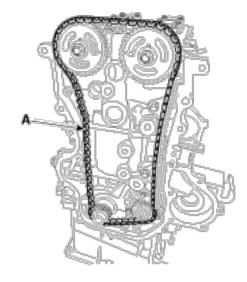
9. Remove the timing chain crank guide (A).



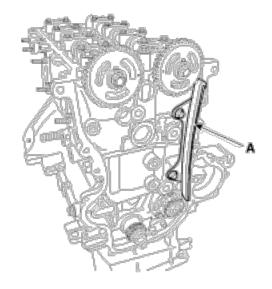
10. Install a set pin after compressing the timing chain tensioner by push the timing chain tensioner arm arrow direction. And then remove the tensioner (A) and the tensioner arm (B).



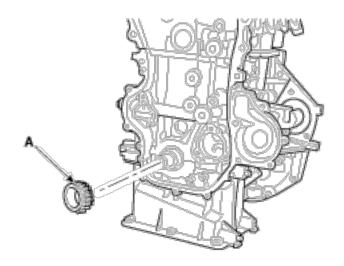
11. Remove the timing chain (A).



12. Remove the timing chain guide (A).



13. Remove the crankshaft sprocket (A).

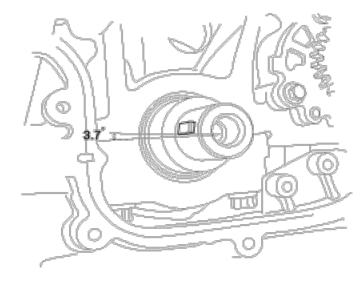


# Sprockets, Chain Tensioner, Chain Guide, Chain Tensioner Arm

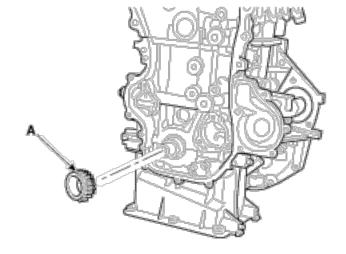
- 1. Check the camshaft sprocket and crankshaft sprocket for abnormal wear, cracks, or damage. Replace as necessary.
- 2. Inspect the tensioner arm and chain guide for abnormal wear, cracks, or damage. Replace as necessary.
- 3. Check that the tensioner piston moves smoothly.

### **INSTALLATION**

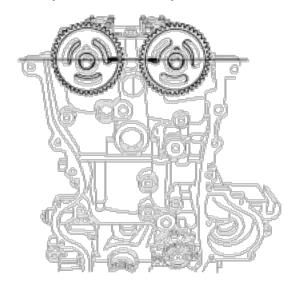
1. Set the key (A) of crankshaft about 3.7° with horizontal center line. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.



2. Install the crankshaft sprocket (A).



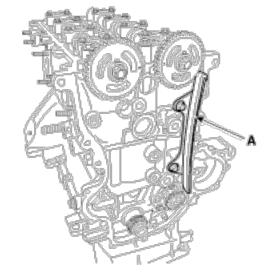
3. Align the mark(A) of cam shaft sprocket on the top surface of cylinder head. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.



4. Install the timing chain guide (A).

#### Tightening torque:

18.6 ~ 21.6N.m (1.9 ~ 2.2kgf.m, 13.7 ~ 15.9lb-ft)



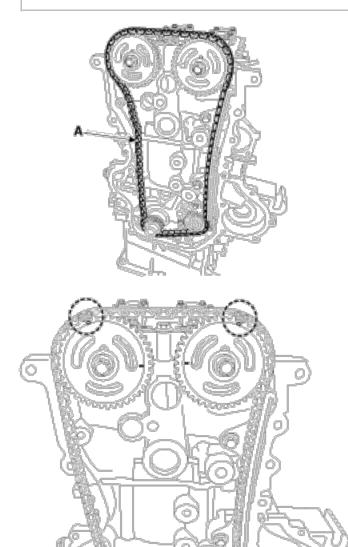
5. Install the timing chain (A).

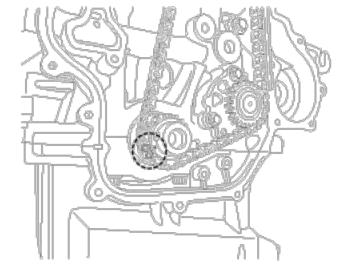
# NOTICE

Install the timing chain with no slack and recommend the below procedure.

Crankshaft sprocket  $\rightarrow$  Oil pump sprocket  $\rightarrow$  Timing chain guide  $\rightarrow$  Intake camshaft sprocket  $\rightarrow$  Exhaust camshaft sprocket.

The timing mark of each sprocket should be matched with timing mark (color link) of timing chain at during installation.

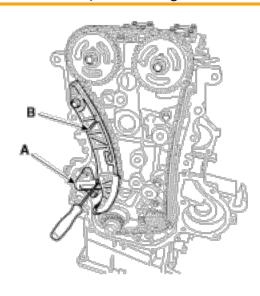




6. Install the timing chain tensioner arm (B) and the timing chain tensioner (A) and then remove the stopper pin.

# Tightening torque:

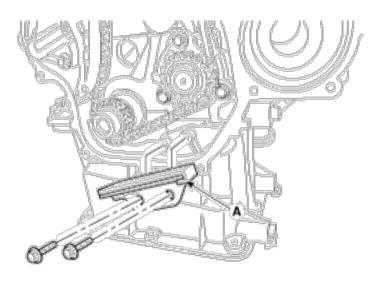
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



7. Install the timing chain crank guide (A).

#### Tightening torque:

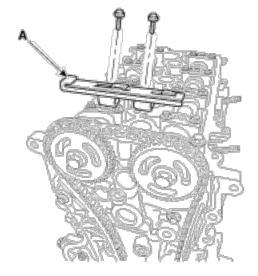
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



8. Install the timing chain cam guide (A).

### **Tightening torque:**

9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



9. After rotating the crankshaft 2 revolutions in regular direction (clockwise viewed from front), confirm the timing mark.

#### NOTICE

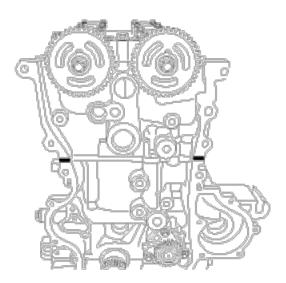
Always turn the crankshaft clockwise.

Turning the crankshaft counter clockwise before building up oil pressure in the hydraulic timing chain tensioner may result in the chain disengaging from the sprocket teeth.

- 10. Install the timing chain cover (A).
  - (1) The sealant locations on chain cover and on counter parts (cylinder head, cylinder block) must be free of engine oil and etc.
  - (2) Before assembling the timing chain cover, the liquid sealant MS721-40AA should be applied on the gap between cylinder head and cylinder block.

The part must be assembled within 5 minutes after sealant was applied.

Bead width: 4.0mm (0.16in.)



(3) After applying liquid sealant MS721-40AA on timing chain cover. The part must be assembled within 5 minutes after sealant was applied.

Sealant should be applied in a continuous bead in each of the areas indicated below.

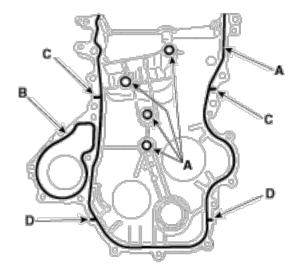
#### **Bead width**

A:  $2.5 \sim 3.5$ mm ( $0.09 \sim 0.14$ in.)

B: 1.5 ~ 2.5mm (0.06 ~ 0.10in.)

C:  $4.5 \sim 5.5$ mm (0.18  $\sim 0.22$ in.)

D: 3.5 ~ 4.5mm (0.14 ~ 0.18in.)



# NOTICE

During timing cover installation, care not to take off applied sealant on the timing cover by contact with other parts.

(4) The dowel pins on the cylinder block and holes on the timing chain cover should be used as a reference in order to assemble the timing chain cover correctly.

### **Tightening torque**

**A**:

18.6 ~ 23.5N.m (1.9 ~ 2.4kgf.m, 13.7 ~ 17.4lb-ft) -5EA

B :

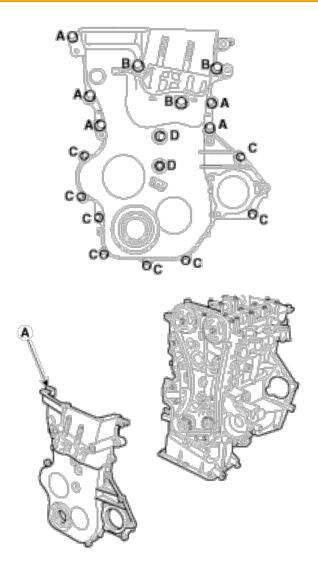
44.1 ~ 53.9N.m (4.5 ~ 5.5kgf.m, 32.5 ~ 39.8lb-ft) -3EA

**C** :

9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft) -8EA

D:

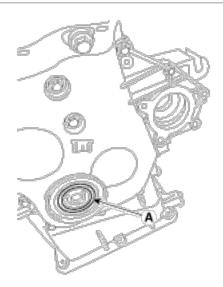
18.6 ~ 23.5N.m (1.9 ~ 2.4kgf.m, 13.7 ~ 17.4lb-ft) -2EA



11. Install the timing chain cover oil seal.

### **NOTICE**

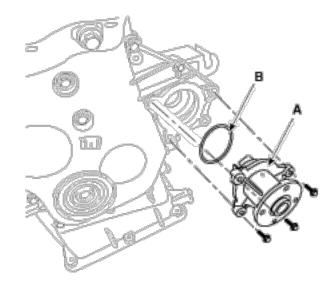
Oil seal should be assembled parallel with chain cover.



12. Install the water pump (A) with the O-ring (B).

#### **Tightening torque:**

9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



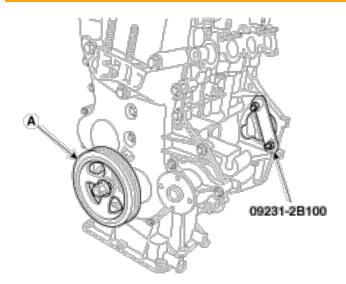
13. Install the crankshaft pulley (A).

### NOTICE

Use the SST (flywheel stopper, 09231-2B100) to install the crankshaft pulley bolt, after remove the starter.

#### **Tightening torque:**

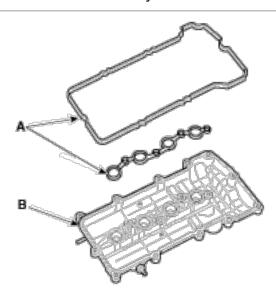
127.5 ~ 137.3N.m (13.0 ~ 14.0kgf.m, 94.0 ~ 101.3lb-ft)



- 14. Install the cylinder head cover.
  - (1) Install new cylinder head cover gasket (A) on the cylinder head cover (B).

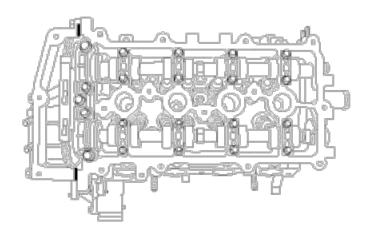
## **▲** CAUTION

Do not reuse the cylinder head cover gasket.



- (2) The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
- (3) After applying sealant (MS721-40AA), it should be assembled within 5 minutes.

**Bead width:** 2.0 ~ 3.0 mm (0.08 ~ 0.12 in.)



(4) Install the cylinder head cover bolts as following method with two steps.

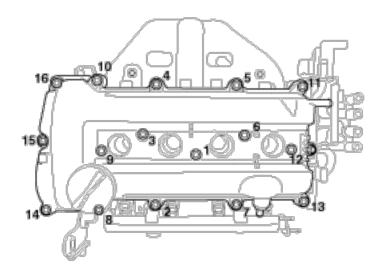
#### **Tightening torque**

Step 1:

 $3.9 \sim 5.9$ N.m (0.4  $\sim 0.6$ kgf.m,  $2.9 \sim 4.3$ lb-ft)

Step 2:

 $7.8 \sim 9.8$ N.m (0.8  $\sim 1.0$ kgf.m,  $5.8 \sim 7.2$ lb-ft)



15. Install the water pump pulley (C).

#### **Tightening torque:**

9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

16. Install the alternator (B).

#### **Tightening torque**

Lower bolt:

29.4 ~ 41.2N.m (3.0 ~ 4.2kgf.m, 21.7 ~ 30.4lb-ft)

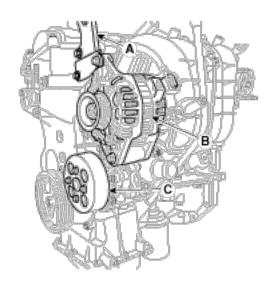
Upper bolt:

19.6 ~ 26.5N.m (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)

17. Install the alternator bracket (A).

#### **Tightening torque:**

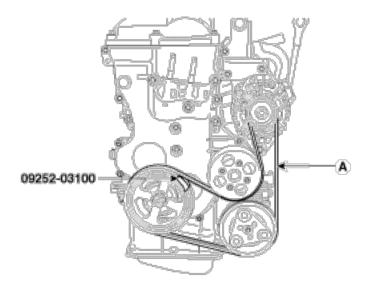
19.6 ~ 26.5N.m (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)



18. Install the drive belt (A).

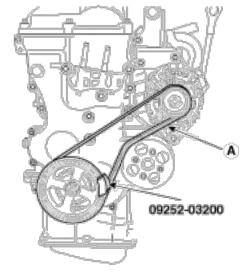
### [Full-option type]

- (1) Pre-position the drive belt on the water pump, alternator, A/C compressor pulleys. Make sure the belt is properly fitted on groove pulleys of alternator and A/C compressor.
- (2) Insert the SST(09252-03100) between the crankshaft pulley and the drive belt.
- (3) Rotate 2 revolutions of crankshaft pulley into counterclockwise direction.
- (4) Remove the tool and make sure the belt is properly installed.



# [Non-A/C type]

- (5) Pre-position the drive belt on the water pump, alternator pulleys. Make sure the belt is properly fitted on groove pulley of alternator.
- (6) Insert the SST(09252-03200) between the crankshaft pulley and the drive belt.
- (7) Rotate 2 revolutions of crankshaft pulley into clockwise direction.
- (8) Remove the tool and make sure the belt is properly installed.



# NOTICE

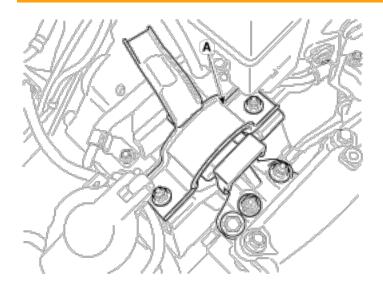
The belt must be free from any harmful damage during installation.

19. Install the engine mounting bracket (A).

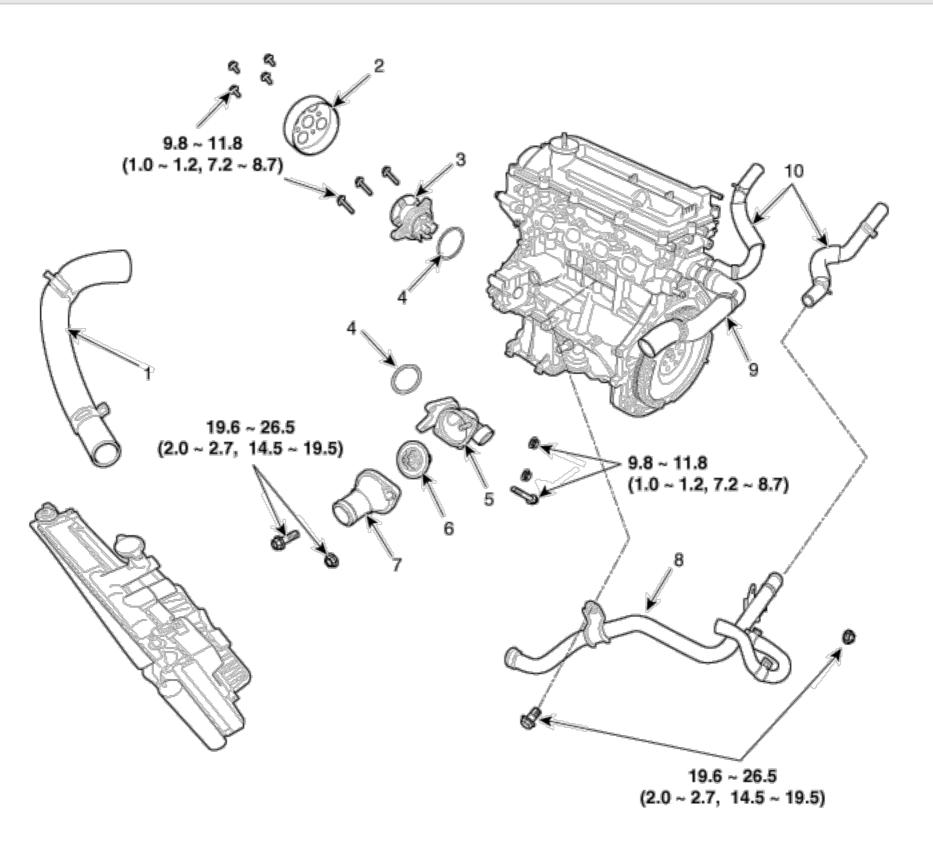
# Tightening torque

Bolts and nuts:

49.0 ~ 63.7Nm (5.0 ~ 6.5kgf.m, 36.1 ~ 47.0lb-ft)



# **COMPONENTS**



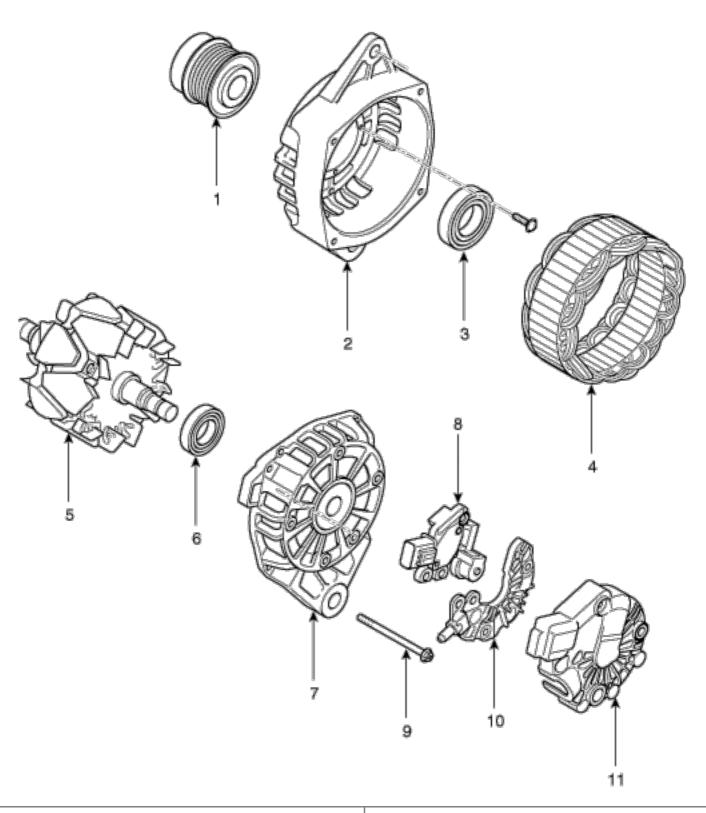
Torque: N.m (kgf.m, lb-ft)

- 1. Radiator lower hose
- 2. Water pump pulley
- 3. Water pump
- 4. O-ring

- 5. Thermostat housing
- 6. Thermostat
- 7. Water inlet fitting

- 8. Heater pipe
- 9. Radiator upper hose
- 10. Heater hose

# **COMPONENTS**



- 1. Drive Belt Pulley
- 2. Front Bracket
- 3. Front Bearing
- 4. Stator
- 5. Rotor
- 6. Rear Bearing

- 7. Rear Bracket
- 8. Brush Holder Assembly
- 9. Through Bolt
- 10. Rectifier Assembly
- 11. Rear Cover

# **DESCRIPTION**

The Alternator has eight built-in diodes, each rectifying AC current to DC current.

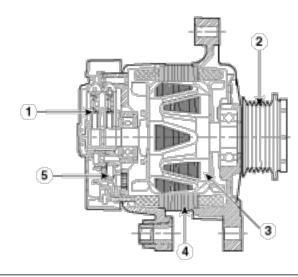
Therefore, DC current appears at alternator "B" terminal.

In addition, the charging voltage of this alternator is regulated by the battery voltage detection system.

The alternator is regulated by the battery voltage detection system.

The main components of the alternator are the rotor, stator, rectifier, capacitor brushes, bearings and V-ribbed belt pulley.

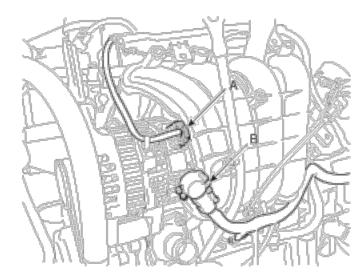
The brush holder contains a built-in electronic voltage regulator.



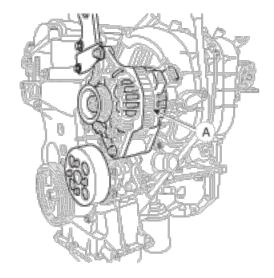
- 1. Brush
- 2. Drive belt pulley
- 3. Rotor
- 4. Stator
- 5. Rectifier

#### **REMOVAL**

- 1. Disconnect the battery negative terminal.
- Remove the drive belt.
   (Refer to Engine Mechanical System "Drive Belt")
- 3. Disconnect the alternator connector (A) and the cable (B) from alternator "B" terminal.



4. Remove the alternator (A).



### **INSTALLATION**

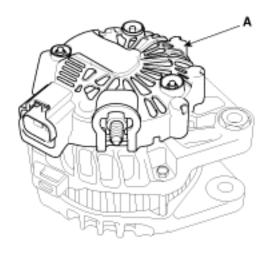
- 1. Install in the reverse order of removal.
- 2. Adjust the alternator belt tension after installation. (Refer to Engine Mechanical System "Drive Belt")

#### **Alternator installation bolt:**

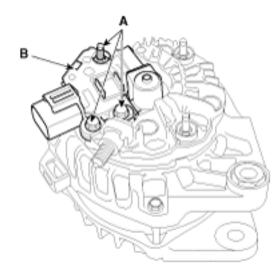
[12mm (0.47in) bolt] 21.6 ~ 32.4 Nm (2.2 ~ 3.3 kgf.m, 15.9 ~ 23.9 lb-ft) [14mm (0.55in) bolt] 29.4 ~ 41.2 Nm (3.0 ~ 4.2 kgf.m, 21.7 ~ 30.4 lb-ft)

#### **DISASSEMBLY**

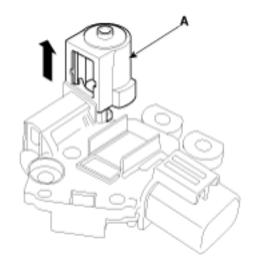
1. Remove the rear cover (A) after removing nuts.



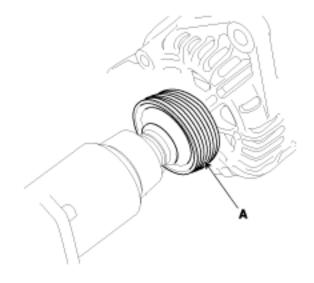
2. Remove the mounting bolts (A) and the brush holder assembly (B).



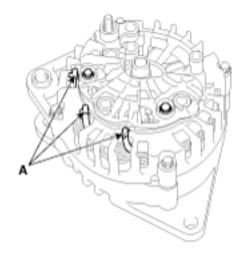
3. Remove the slip ring guide (A) after pulling it.



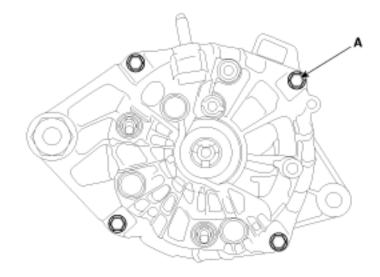
4. Remove the drive belt pulley (A).



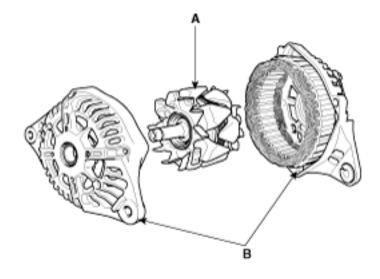
5. Unsolder the 3 stator leads (A).



6. Remove the 4 through bolts (A).



7. Disconnect the rotor (A) and bracket (B).



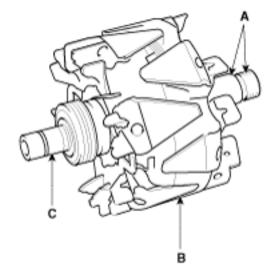
# **REASSEMBLY**

1. Reassemble in the reverse order of disassembly.

# **INSPECTION**

# [Rotor]

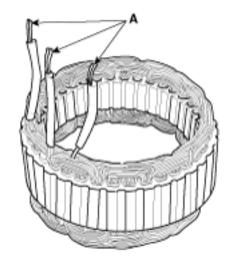
1. Check that there is continuity between the slip rings (C).



- 2. Check that there is no continuity between the slip rings and the rotor (B) or rotor shaft (A).
- 3. If the rotor fails either continuity check, replace the alternator.

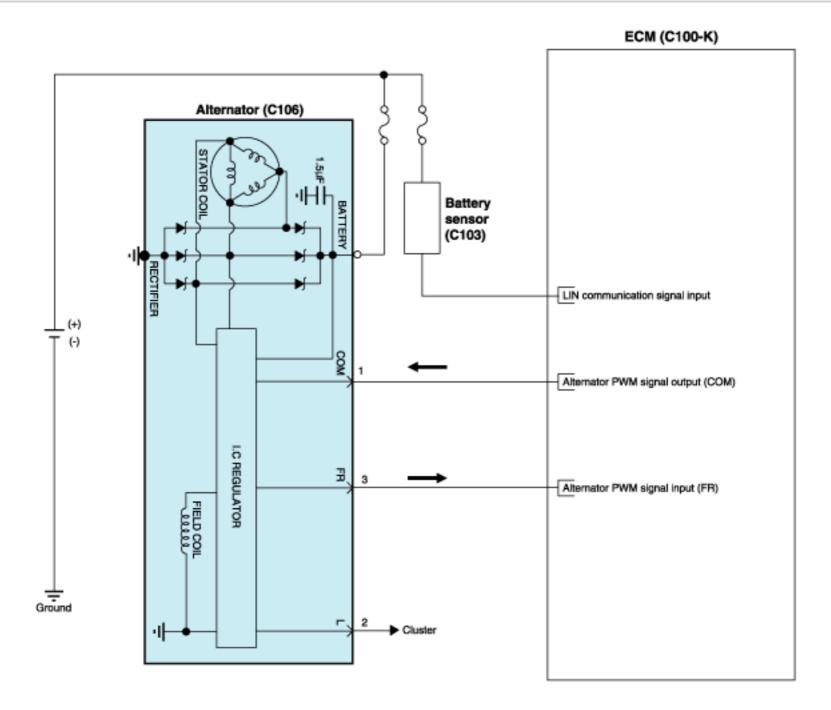
### [Stator]

4. Check that there is continuity between each pair of leads (A).



- 5. Check that there is no continuity between each lead and the coil core.
- 6. If the coil fails either continuity check, replace the alternator.

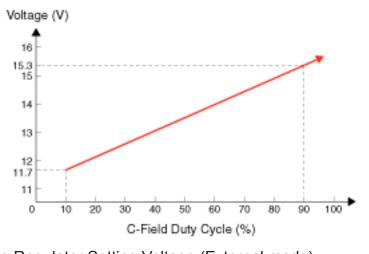
# **CIRCUIT DIAGRAM**



# **SPECIFICATION**

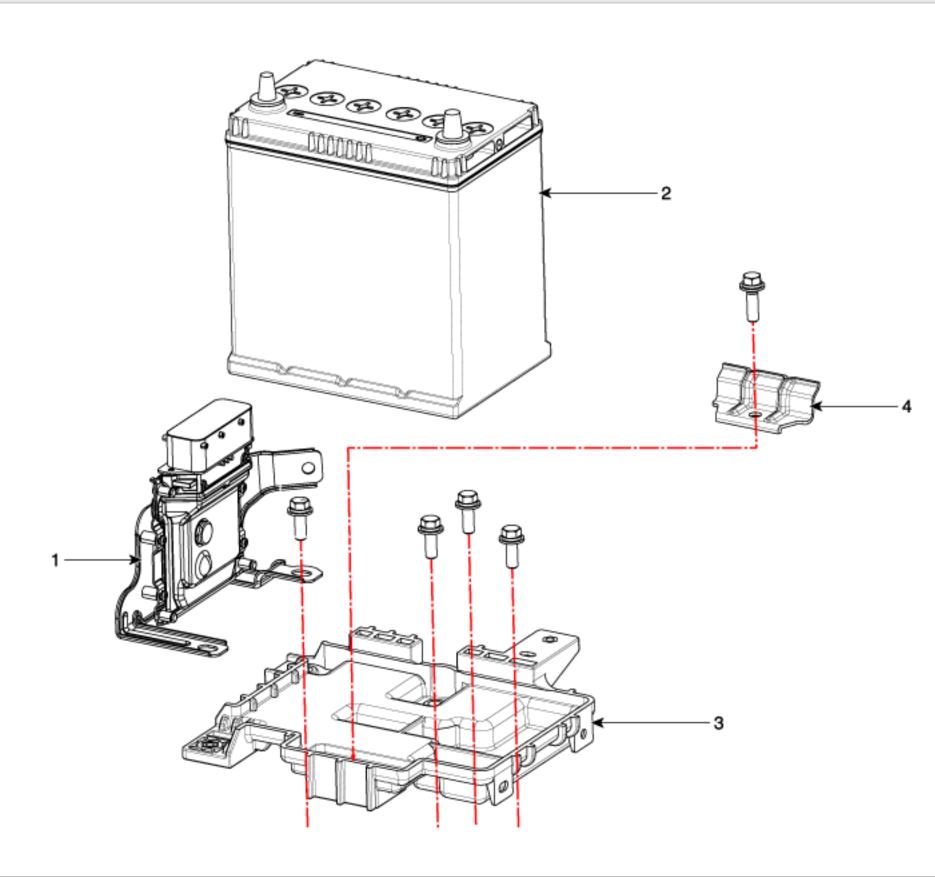
#### **Alternator**

Item		Specification
Rated voltage		13.5V, 90A
Speed in use		1,000 ~ 18,000 rpm
Voltage regulator		IC Regulator built-in type
Regulator Setting Voltage	External mode	Refer to below graph
	Internal mode	14.55 ± 0.2V
Temperature Gradient	External mode	0 ± 3 mV / °C
	Internal mode	-7 ± 3mV / °C



\* Regulator Setting Voltage (External mode)

# **COMPONENTS**

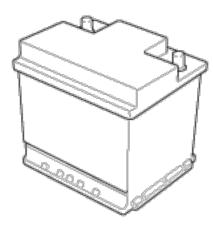


- 1. ECM
- 2. Battery

- 3. Battery tray
- 4. Battery mounting bracket

# **DESCRIPTION**

- 1. The MF(Maintenance Free) battery is, as the name implies, totally maintenance free and has no removable battery cell caps.
- 2. The MF(Maintenance Free) battery does not require water replenishment for the repair.
- 3. The battery is completely sealed, except for small vent holes in the cover.



# 1 Information

 After disconnecting then reconnecting the battery negative cable, reset some parts that require the reset procedures.

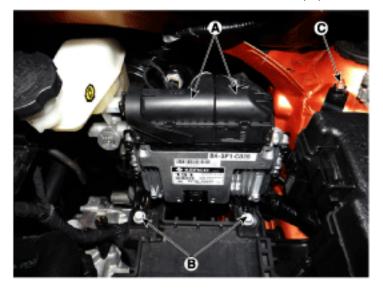
(Refer to Body Electrical System - "General Information")

### **REMOVAL**

- 1. Disconnect the battery (-)terminal (A) and then (+)terminal (B).
- 2. Remove the battery mounting bracket (C) and then remove the battery.



- 3. Disconnect the ECM connector (A).
- 4. Remove the bracket installation bolts (B) and nut (C).



5. Remove the battery tray installation bolts (A).



### **INSTALLATION**

1. Install in the reverse order of removal.

**Battery (-)terminal installation:** 

 $7.8 \sim 9.8 \text{ N.m}$  (0.8 ~ 1.0 kgf.m,  $5.8 \sim 7.2 \text{ lb-ft}$ )

**Battery (+)terminal installation:** 

 $7.8 \sim 9.8 \text{ N.m}$  (0.8 ~ 1.0 kgf.m,  $5.8 \sim 7.2 \text{ lb-ft}$ )

Battery mounting bracket insulation bolt :

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

**Battery tray installation bolts:** 

8.8 ~ 13.7 N.m (0.9 ~ 1.4 kgf.m, 6.5 ~ 10.1 lb-ft)

#### VEHICLE PARASITIC CURRENT INSPECTION

- 1. Turn the all electric devices OFF, and then turn the ignition switch OFF.
- 2. Close all doors except the engine hood, and then lock all doors.
  - (1) Disconnect the hood switch connector.
  - (2) Close the trunk lid.
  - (3) Close the doors or remove the door switches.
- 3. Wait a few minutes until the vehicle's electrical systems go to sleep mode.

#### NOTICE

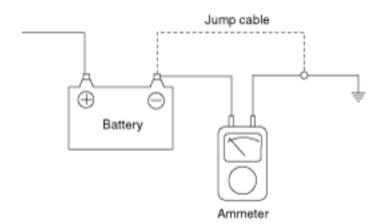
- For an accurate measurement of a vehicle parasitic current, all electriacl systems should go to sleep mode. (It takes at least one hour or at most one day.) However, an approximate vehicle parasitic current can be measured after 10~20 minutes.
- 4. Connect an ammeter in series between the battery (-) terminal and the ground cable, and then disconnect the clamp from the battery (-) terminal slowly.

#### NOTICE

• Be careful that the lead wires of an ammeter do not come off from the battery (-) terminal and the ground cable to prevent the battery from being reset. In case the battery is reset, connect the battery cable again, and then start the engine or turn the ignition switch ON for more than 10 sec. Repeat the procedure from No. 1.

To prevent the battery from being reset during the inspection,

- a. Connect a jump cable between the battery (-) terminal and the ground cable.
- b. Disconnect the ground cable from the battery (-) terminal.
- c. Connect an ammeter between the battery (-) terminal and the ground cable.
- d. After disconnecting the jump cable, read the current value of the ammeter.



- 5. Read the current value of the ammeter.
  - If the parasitic current is over the limit value, search for abnormal circuit by removing a fuse one by one and checking the parasitic current.
  - Reconnect the suspected parasitic current draw circuit fuse only and search for suspected unit by removing a compoconnected with the circuit one by one until the parasitic draw drops below limit value.

Limit value (after 10~20 min.): Below 50mA

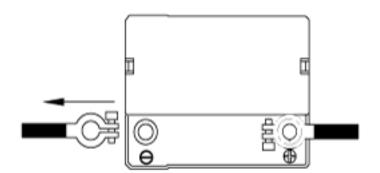
#### **CLEANING**

- 1. Make sure the ignition switch and all accessories are in the OFF position.
- 2. Disconnect the battery cables (negative first).
- 3. Remove the battery from the vehicle.

# **▲** CAUTION

 Care should be taken in the event the battery case is cracked or leaking, to protect your skin from the electrolyte.

Heavy rubber gloves (not the household type) should be wore when removing the battery.



- 4. Inspect the battery tray for damage caused by the loss of electrolyte. If acid damage is present, it will be necessary to clean the area with a solution of clean warm water and baking soda. Scrub the area with a stiff brush and wipe off with a cloth moistened with baking soda and water.
- 5. Clean the top of the battery with the same solution as described above.
- 6. Inspect the battery case and cover for cracks. If cracks are present, the battery must be replaced.
- 7. Clean the battery posts with a suitable battery post tool.

- 8. Clean the inside surface of the terminal clamps with a suitable battery cleaning tool. Replace damaged or frayed cables and broken terminal clamps.
- 9. Install the battery in the vehicle.
- 10. Connect the cable terminals to the battery post, making sure tops of the terminals are flush with the tops of the posts .
- 11. Tighten the terminal nuts securely.
- 12. Coat all connections with light mineral grease after tightening.

## **▲** CAUTION

- When batteries are being charged, an explosive gas forms beneath the cover of each cell. Do not smoke near batteries being charged or which have recently been charged. Do not break live circuit at the terminals of batteries being charged.
  - A spark will occur when the circuit is broken. Keep open flames away from battery.

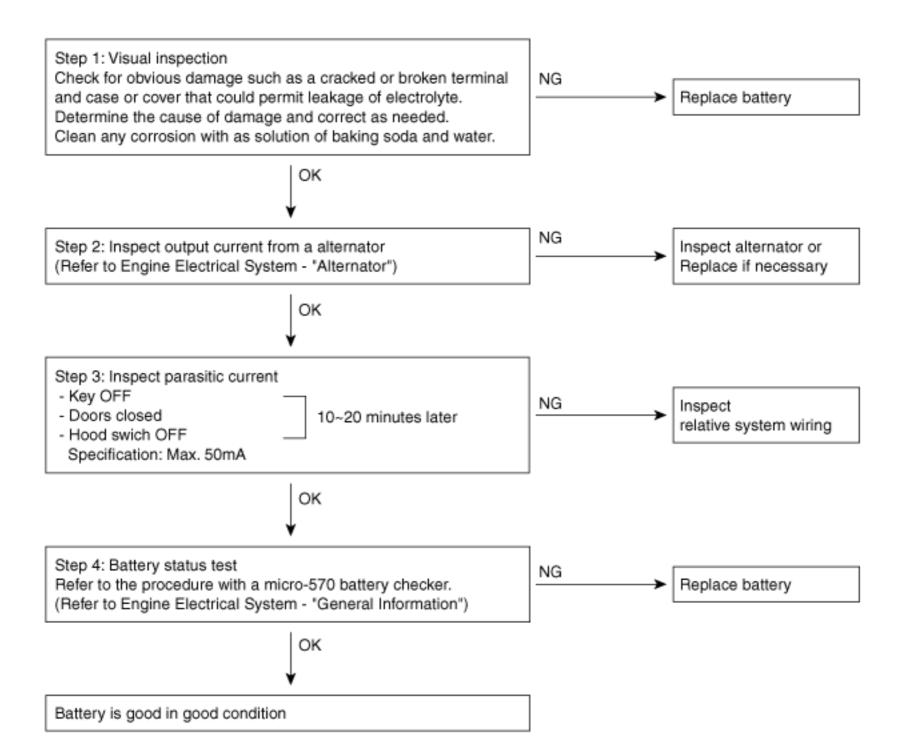
2016 > G 1.2 MPI > G 1.2 MPI > Engine Electrical System > Charging System > Battery > Specifications

# **SPECIFICATIONS**

# ► CMF40L-DIN

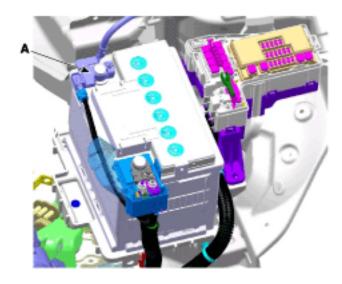
ltem	Specification
Capacity [20HR/5HR] (AH)	40/32
Cold Cranking Amperage (A)	290 (SAE) / 360 (EN)
Reserve Capacity (Min)	55

### **TROUBLESHOOTING**



#### **DESCRIPTION**

Vehicles have many control units that use more electricity. These units control their own system based on information from diverse sensors. It is important to have a stable power supply as there diverse sensors giving a variety of information. Battery sensor (A) is mounted on battery (-) terminal. It transmits battery voltage, current, temperature information to ECM. ECM controls generating voltage by duty cycle based on these signals.



### **▲** CAUTION

When battery sensor signal fault occurs, inspect the vehicle parasitic draw in advance after inspecting the sensor because the sensor will behave abnormally when the parasitic draw is more than 100mA. (Refer to vehicle parasitic current inspection)

#### NOTICE

It takes a few hours for a new battery sensor to detect the battery state correctly. Perform the following process after replacing the battery sensor.

- 1) Ignition switch ON/OFF.
- 2) Park the vehicle about 4 hours.
- 3) After 4 hours later, check that the SOC (State of charge) of battery is displayed on GDS properly.
- 4) After engine start ON/OFF 2 times or more, check the SOF (State of function) of battery using GDS.

## **▲** CAUTION

For the vehicle equipped with a battery sensor, be careful not to damage the battery sensor when the battery is replaced or recharged.

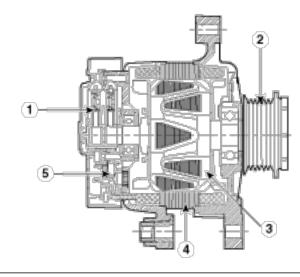
- When replacing the battery, it should be same one (type, capacity and brand) that is originally installed on your vehicle. If a battery of a different type is replaced, the battery sensor may recognize the battery to be abnormal.
- When installing the ground cable on the negative post of battery, tighten the clamp with specified torque of 4.0~6.0N.m (0.4~0.6kgf.m, 3.0~4.4lb-ft). An excessive tightening torque can damage the PCB internal circuit and the battery terminal.
- When recharging the battery, ground the negative terminal of the booster battery to the vehicle body.

#### **DESCRIPTION**

The charging system included a battery, an alternator with a built-in regulator, and the charging indicator light and wire.

- The Alternator has eight built-in diodes, each rectifying AC current to DC current.
- Therefore, DC current appears at alternator "B" terminal.
- In addition, the charging voltage of this alternator is regulated by the battery voltage detection system.

The alternator is regulated by the battery voltage detection system. The main components of the alternator are the rotor, stator, rectifier, capacitor brushes, bearings and V-ribbed belt pulley. The brush holder contains a built-in electronic voltage regulator.



- 1. Brush
- 2. Drive belt pulley
- 3. Rotor
- 4. Stator
- 5. Rectifier

#### **Alternator Management System**

Alternator management system controls the charging voltage set point in order to improve fuel economy, manage alternator load under various operating conditions, keep the battery charged, and protect the battery from over-charging. ECM controls generating voltage by duty cycle (charging control, discharging control, normal control) based on the battery conditions and vehicle operating conditions.

The system conducts discharging control when accelerating a vehicle. Vehicle reduces an alternator load and consumes an electric power form a battery.

The system conducts charging control when decelerating a vehicle. Vehicle increases an alternator load and charges a battery.

### **ON-VEHICLE INPECTION**

## i Information

• First of all, check for DTCs. If a DTC is present, perform troubleshooting in accordance with the procedure for that DTC. (Refer to DTC guide)

## **▲** CAUTION

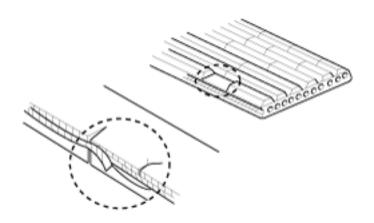
- Check that the battery cables are connected to the correct terminals.
- Disconnect the battery cables when the battery is given a quick charge.
- Never disconnect the battery while the engine is running.

### [General Inspection]

- 1. Check The Battery Terminals And Fuses
  - (1) Check that the battery terminals are not loose or corroded.
  - (2) Check the fuses for continuity.
- 2. Inspect Drive Belt
  - (1) Visually check the belt for excessive wear, frayed cords etc. If any defect has been found, replace the drive belt.

#### NOTICE

• Cracks on the rib side of a belt are considered acceptable. If the belt has chunks missing from the ribs, it should be replaced.



- Drive belt tension measurement and adjustment.
   (Refer to Engine Mechanical System "Drive Belt")
- 4. Visually Check Alternator Wiring And Listen For Abnormal Noises
  - (1) Check that the wiring is in good condition.
  - (2) Check that there is no abnormal noise from the alternator while the engine is running.
- 5. Check Discharge Warning Light Circuit

- (1) Warm up the engine and then turn it off.
- (2) Turn off all accessories.
- (3) Turn the ignition switch "ON". Check that the discharge warning light is lit.
- (4) Start the engine. Check that the light is lit.

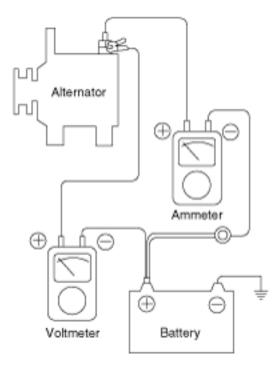
  If the light does not go off as specified, troubleshoot the discharge light circuit.

#### [Electrical Specified Value Inspection]

6. Voltage Drop Test Of Alternator Output Wire

This test determines whether or not the wiring between the alternator "B" terminal and the battery (+) terminal is good by the voltage drop method.

- (1) Preparation
  - a. Turn the ignition switch to "OFF".
  - b. Disconnect the output wire from the alternator "B" terminal. Connect the (+) lead wire of ammeter to the "B" terminal of alternator and the (-) lead wire of ammeter to the output wire. Connect the (+) lead wire of voltmeter to the "B" terminal of alternator and the (-) lead wire of voltmeter to the (+) terminal of battery.



#### (2) Test

- a. Start the engine.
- b. Turn on the headlamps and blower motor, and set the engine speed until the ammeter indicates 20A. And then, read the voltmeter at this time.
- (3) Result
  - a. The voltmeter may indicate the standard value.

#### Standard value: 0.2V max

- b. If the value of the voltmeter is higher than expected (above 0.2V max.), poor wiring is suspected. In this case check the wiring from the alternator "B" terminal to the battery (+) terminal. Check for loose connections, color change due to an over-heated harness, etc. Correct them before testing again.
- c. Upon completion of the test, set the engine speed at idle.

  Turn off the headlamps, blower motor and the ignition switch.

#### 7. Output Current Test

This test determines whether or not the alternator gives an output current that is equivalent to the normal output.

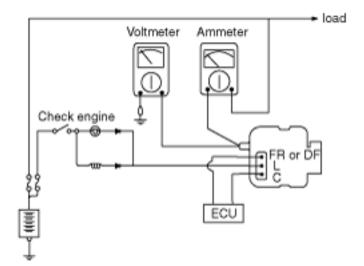
(1) Preparation

- a. Prior to the test, check the following items and correct as necessary.

  Check the battery installed in the vehicle to ensure that it is good condition. The battery checking method
  - Check the battery installed in the vehicle to ensure that it is good condition. The battery checking method is described in the section "Battery".
  - The battery that is used to test the output current should be one that has been partially discharged. With a fully charged battery, the test may not be conducted correctly due to an insufficient load.
  - Check the tension of the alternator drive belt. The belt tension check method is described in the section "Inspect drive belt".
- b. Turn off the ignition switch.
- c. Disconnect the battery ground cable.
- d. Disconnect the alternator output wire from the alternator "B" terminal.
- e. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire. Be sure to connect the (-) lead wire of the ammeter to the disconnected output wire.

### NOTICE

- Tighten each connection securely, as a heavy current will flow. Do not rely on clips.
- f. Connect a voltmeter (0 to 20V) between the "B" terminal and ground. Connect the (+) lead wire to the alternator "B" terminal and (-) lead wire to a good ground.
- g. Attach an engine tachometer and connect the battery ground cable.
- h. Leave the engine hood open.



#### (2) Test

- a. Check to see that the voltmeter reads as the same value as the battery voltage. If the voltmeter reads 0V, and the open circuit in the wire between alternator "B" terminal and battery (+) terminal or poor grounding is suspected.
- b. Start the engine and turn on the headlamps.
- c. Set the headlamps to high beam and the heater blower switch to HIGH, quickly increase the engine speed to 2,500 rpm and read the maximum output current value indicated by the ammeter.

## NOTICE

• After the engine start up, the charging current quickly drops. Therefore, the above operation must be done quickly to read the maximum current value correctly.

### (3) Result

a. The ammeter reading must be higher than the limit value. If it is lower but the alternator output wire is in good condition, remove the alternator from the vehicle and test it.

**Limit value :** 60% of the voltage rate

### NOTICE

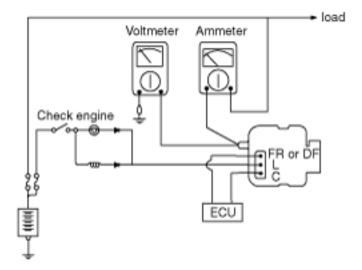
- The nominal output current value is shown on the nameplate affixed to the alternator body.
- The output current value changes with the electrical load and the temperature of the alternator itself.
  - Therefore, the nominal output current may not be obtained. If such is the case, keep the headlamps on the cause discharge of the battery, or use the lights of another vehicle to increase the electrical load.
- The nominal output current may not be obtained if the temperature of the alternator itself or ambient temperature is too high. In such a case, reduce the temperature before testing again.
- b. Upon completion of the output current test, lower the engine speed to idle and turn off the ignition switch.
- c. Disconnect the battery ground cable.
- d. Remove the ammeter and voltmeter and the engine tachometer.
- e. Connect the alternator output wire to the alternator "B" terminal.
- f. Connect the battery ground cable.

### 8. Regulated Voltage Test

The purpose of this test is to check that the electronic voltage regulator controls voltage correctly.

#### (1) Preparation

- a. Prior to the test, check the following items and correct if necessary.
  - Check that the battery installed on the vehicle is fully charged. The battery checking method is described in the section "Battery".
  - Check the alternator drive belt tension. The belt tension check method is described in the section "Inspect drive belt".
- b. Turn ignition switch to "OFF".
- c. Disconnect the battery ground cable.
- d. Connect a digital voltmeter between the "B" terminal of the alternator and ground. Connect the (+) lead of the voltmeter to the "B" terminal of the alternator. Connect the (-) lead to good ground or the battery (-) terminal.
- e. Disconnect the alternator output wire from the alternator "B" terminal.
- f. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire. Connect the (-) lead wire of the ammeter to the disconnected output wire.
- g. Attach the engine tachometer and connect the battery ground cable.



a. Turn on the ignition switch and check to see that the voltmeter indicates the following value.

### Voltage: Battery voltage

If it reads 0V, there is an open circuit in the wire between the alternator "B" terminal and the battery and the battery (-) terminal.

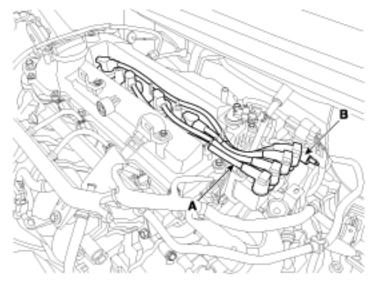
- b. Start the engine. Keep all lights and accessories off.
- c. Run the engine at a speed of about 2,500 rpm and read the voltmeter when the alternator output current drops to 10A or less

## (3) Result

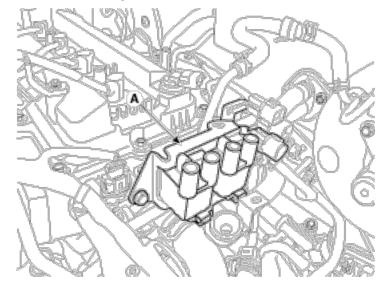
- a. If the voltmeter reading dosen't agree with the standard value, the voltage regulator or the alternator is faulty.
- b. Upon completion of the test, reduce the engine speed to idle, and turn off the ignition switch.
- c. Disconnect the battery ground cable.
- d. Remove the voltmeter and ammeter and the engine tachometer.
- e. Connect the alternator output wire to the alternator "B" terminal.
- f. Connect the battery ground cable.

## **REMOVAL**

- 1. Disconnect the battery nagative terminal.
- Remove the air cleaner.
   (Refer to Engine Mechanical System "Air Cleaner")
- 3. Disconnect the spark plug cable (A) and ignition coil connector (B).



4. Remove the ignition coil (A).



## **INSTALLATION**

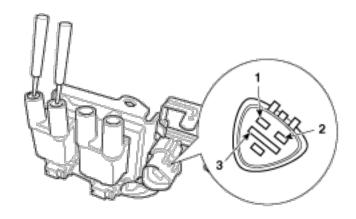
1. Install in the reverse order of removal.

Ignition coil installation bolts:

 $18.6 \sim 23.5 \text{ N.m} (1.9 \sim 2.4 \text{ kgf.m}, 13.7 \sim 17.4 \text{ lb-ft})$ 

### **INSPECTION**

1. Measure the primary coil resistance between terminals 1, 2 and 1, 3.



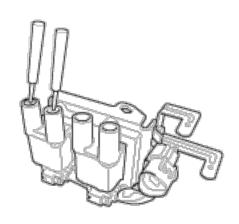
Standard value :  $0.82\Omega \pm 10\%$ 

2. Measure the secondary coil resistance between the high-voltage terminals for the No.1 and No. 4 cylinders, and between the high voltage terminals for the No. 2 and No. 3 cylinders.

Standard value :  $15.5k\Omega/m \pm 15\%$ 

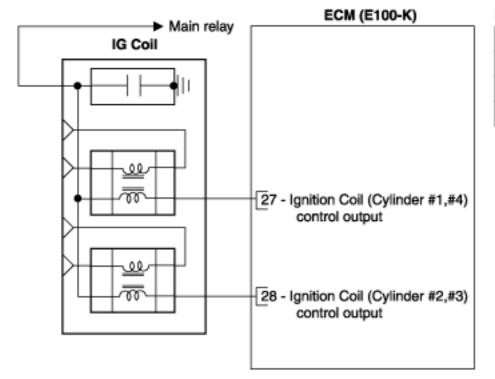
## **▲** CAUTION

Be sure, when measuring the resistance of the secondary coil, to disconnect the connector of the ignition coil.



### **CIRCUIT DIAGRAM**

### [Circuit Diagram]



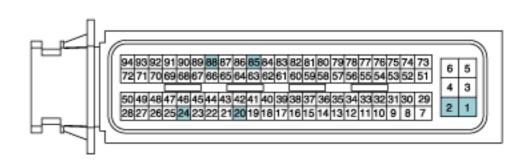
### [Connection Information]

### Ignition Coil

Terminal	Connected to	Function
1	ECM E100-K (27)	Ignition Coil (Cylinder #1,#4) control
2	ECM E100-K (28)	Ignition Coil (Cylinder #2,#3) control
3	Main relay	Battery power (B+)

### [Harness Connector]





E100-K

ECM

# SPECIFICATION

ltem	Specification
Primary Coil Resistance (Ω)	0.82 ± 10% [20°C (68°F)]
Secondary Coil Resistance (kΩ)	15.5 ± 15% [20°C (68°F)]

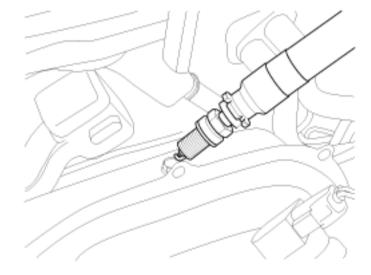
### **ON-VEHICLE INSPECTION**

### Inspect ignition coil assembly and Perform spark test

1. Check for DTCs.

### NOTICE

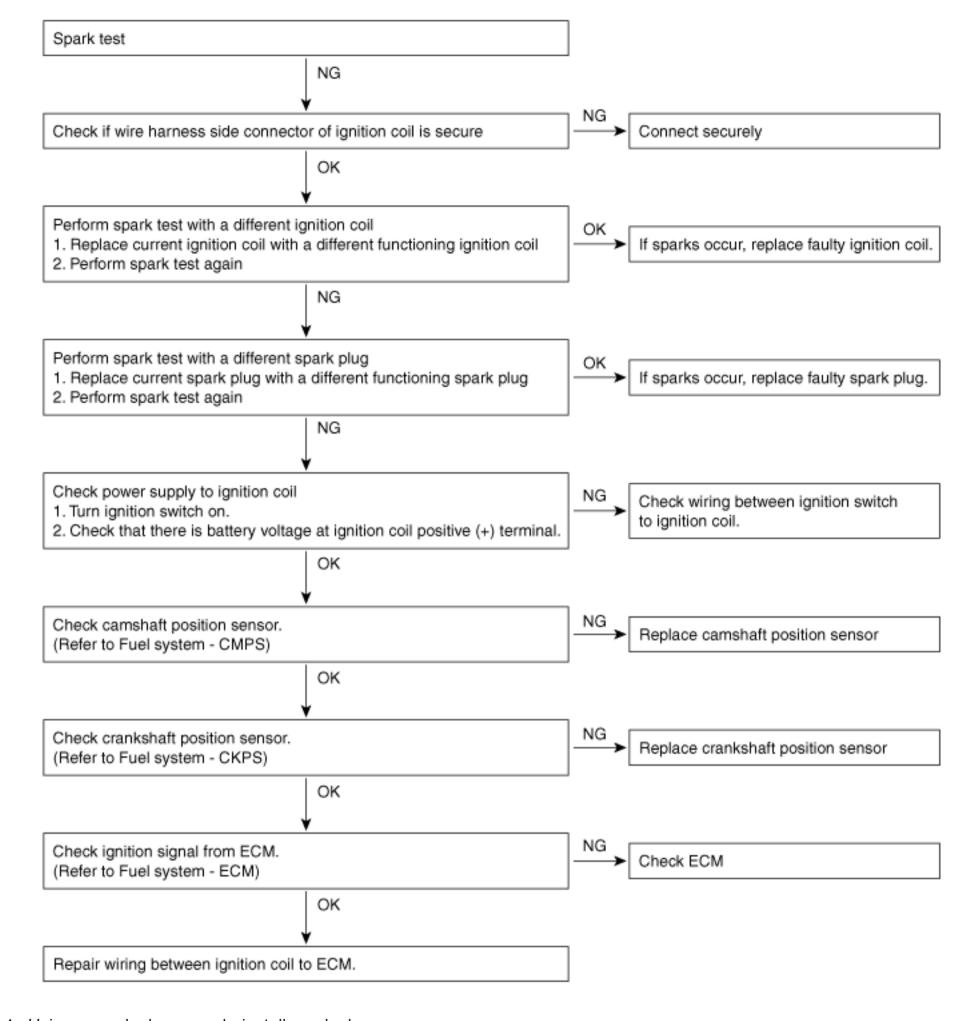
- If a DTC is present, perform troubleshooting in accordance with the procedure for that DTC. (Refer to DTC guide)
- 2. Check if sparks occur.
  - (1) Remove the engine cover.
  - (2) Remove the cylinder head center cover.
  - (3) Remove the ignition coils.
  - (4) Using a spark plug wrench, remove the spark plugs.
  - (5) Disconnect the 4 injector connectors.
  - (6) Ground the spark plug to the engine.



(7) Check if sparks occur at each spark plug while engine is being cranked.

## NOTICE

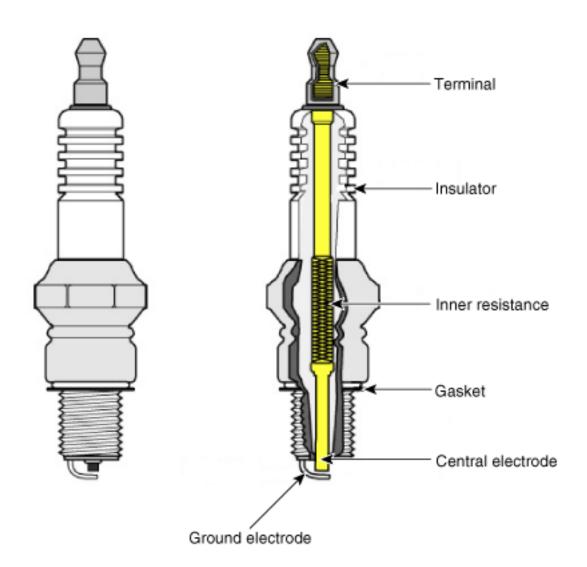
- Do not crank the engine for more then 5 seonds.
- 3. If sparks do not occur, perform the following test.



- 4. Using a spark plug wrench, install spark plugs.
- 5. Install the ignition coils.
- 6. Install the cylinder head center cover and the engine cover.

## **DESCRIPTION**

A spark plug is a device for delivering electric current from an ignition system to the combustion chamber of a spark-ignition engine to ignite the compressed fuel/air mixture therein by means of an electric spark, while containing combustion pressure within the engine. A spark plug has a metal threaded shell, electrically isolated from a central electrode by a porcelain insulator.



### **INSPECTION**

### [On vehicle inspection]

- 1. Accelerate the engine to about 3,000 rpm 3 times or more.
- 2. Remove the spark plug.
- Check the spark plug visually.
   If the electrode is dry, the spark plug is normal.
   If the electrode is wet, check the damage and electrode gap as below.

### [Component Inspection]

- 4. Check the spark plug for any damage on its thread and insulator. If there is damage, replace the spark plug.
- 5. Check the electrode. Measure the insulation resistance with an ohmmeter. If the resistance is less than the specified value, adjust the electrode gap.

**Specification:** 10 M $\Omega$  or more

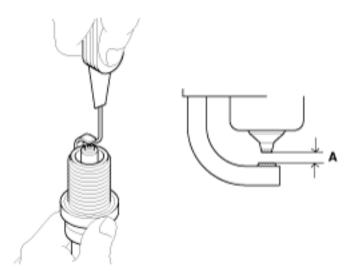


6. Check the spark plug electrode gap.

If the gap is greater than the maximum, replace the spark plug.

### NOTICE

• If adjusting the gap of a new spark plug, bend only the base of the ground electrode. Do not touch the tip. Never attempt to adjust the gap on a used plug.

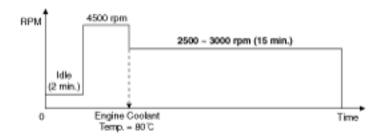


### **CLEANING**

The combustion temporarily becomes unstable, due to the aged fuel and the carbon deposits accumulated on the spark plug(s) after long-term storage.

### [1st Method]

- 1. Start the engine and keep the engine running at idle for 2 minutes.
- 2. Step on the accelerator pedal and hold it steady at 4500 rpm with the shift lever in N position to warm up the engine until the temperature of the engine coolant reaches 80°C.
- 3. Keep the engine running at 2500~3000 rpm in the N position for 15 minutes.



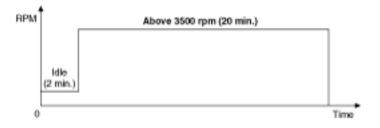
### [2nd Method]

### NOTICE

- The 2nd method should be performed only if the 1st method fails (the misfire-related codes recur).
- 4. Start the engine and keep the engine running at idle for 2 minutes.
- 5. Drive the vehicle for over 20 minutes, keeping the engine speed above 3500 rpm.

### NOTICE

• If equipped with manual transaxle, shift the gear properly for keeping the engine speed above 3500 rpm.

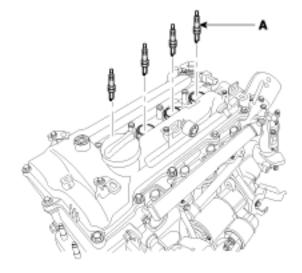


### **REMOVAL**

- Remove the ignition coil.
   (Refer to Ignition System "Ignition Coil")
- 2. Using a spark plug wrench, remove the spark plug (A).

### NOTICE

Be careful that no contaminates enter into spark plug holes.



# **INSTALLATION**

1. Install in the reverse order of removal.

## Tightening torque:

14.7 ~ 24.5 N.m (1.5 ~ 2.5 kgf.m, 10.8 ~ 18.0 lb-ft)

# SPECIFICATION

Item		Specification	
	Туре	Unleaded	RER8WYPB4
		Leaded	RER8YC-L3
Spark plugs	Gap	Unleaded	0.9 ~ 1.0 mm (0.0354 ~ 0.0394in.)
		Leaded	0.7 ~ 0.8 mm (0.0276 ~ 0.0315in.)

# **SPECIFICATION**

## **Ignition System**

## Ignition Coil

ltem	Specification
Primary Coil Resistance (Ω)	0.82 ± 10% [20°C (68°F)]
Secondary Coil Resistance (kΩ)	15.5 ± 15% [20°C (68°F)]

## Spark plug

Item			Specification
	Туре	Unleaded	RER8WYPB4
		Leaded	RER8YC-L3
Spark plugs	Gap	Unleaded	0.9 ~ 1.0 mm (0.0354 ~ 0.0394in.)
		Leaded	0.7 ~ 0.8 mm (0.0276 ~ 0.0315in.)

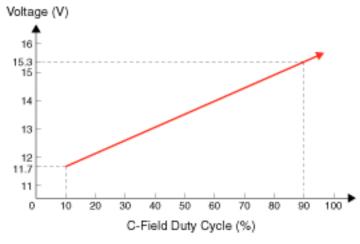
### Condenser

ltem	Specification
Capacitance (uF)	0.47 [1KHz]
Insulation resistance (MΩ)	1,000 [DC 500 V/1 Min]

## **Charging System**

### Alternator

Item	Specification		
Rated voltage		13.5V, 90A	
Speed in use		1,000 ~ 18,000 rpm	
Voltage reg	IC Regulator built-in type		
Dogulator Catting Valtage	External mode	Refer to below graph	
Regulator Setting Voltage	Internal mode	14.55 ± 0.2V	
Tomporature Cradient	External mode	0 ± 3 mV / °C	
Temperature Gradient	Internal mode	-7 ± 3mV / °C	



\* Regulator Setting Voltage (External mode)

#### **Battery**

### ► CMF40L-DIN

ltem	Specification
Capacity [20HR/5HR] (AH)	40/32
Cold Cranking Amperage (A)	290 (SAE) / 360 (EN)
Reserve Capacity (Min)	55

## i Information

- · Model type description
  - - : Battery specification
      - CMF : Closed Maintenance Free
      - MF: Maintenance Free
      - AGM : Absorbent Glass Mat
    - 2 : Battery capacity (20HR)
      - 68 : 68AH
    - 3 : Terminal location
      - L : Positive terminal is left
      - R : Positive terminal is right
    - 4 : Battery type
      - DIN: Deutsche Industric Normen
      - BCI: Battery Council International
- Cold Cranking Ampere (CCA): Cold Cranking Amps is a rating used in the battery industry to define a battery's ability to start an engine in cold temperatures.
- The rating is the number of amps a new, fully charged battery can deliver at -18 °C(-0.4 °F) for 30 seconds, while maintaining a voltage of at least 7.2 volts for a 12 volt battery.
- The higher the CCA rating, the greater the starting power of the battery.
- RESERVE CAPACITY (RC): Reserve Capacity is a battery industry rating, defining a battery's ability to power a vehicle with an inoperative alternator or fan belt.
- The rating is the number of minutes a battery at 26.7 °C(80 °F) can be discharged at 25 amps and maintain a voltage of 10.5 volts for a 12 volt battery.
- The higher the reserve rating, the longer your vehicle can operate should your alternator or fan belt fail.

#### **Starting System**

#### Starter

Item		Specification
Rated voltage		12 V, 0.9 kW
The number of pinion teeth		10
Performance	Ampere	Max. 58 A
[No-load, 11.5 V]	Speed	Min. 3000 rpm

# **TIGHTENING TORQUES**

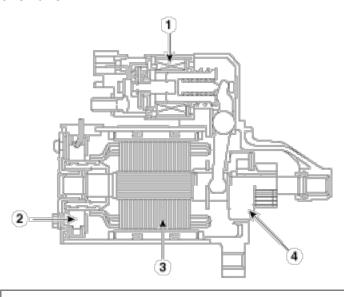
Item	N.m	kgf.m	lb-ft
ILGIII	N.III	Kgi.iii	10-10
Ignition coil installation bolt	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Spark plug installation	14.7 ~ 24.5	1.5 ~ 2.5	10.9 ~ 18.1
Condenser & Hanger bracket installation bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Alternator installation bolt [12 mm (0.47 in.)]	19.6 ~ 26.5	2.2 ~ 3.3	14.5 ~ 19.5
Alternator installation bolt [14 mm (0.55 in.)]	29.4 ~ 41.2	3.0 ~ 4.2	21.7 ~ 30.4
Battery (+) terminal tightening nut	7.8 ~ 9.8	0.8 ~ 1.0	5.2 ~ 8.7
Battery (-) terminal I tightening nut	7.8 ~ 9.8	0.8 ~ 1.0	5.2 ~ 8.7
Battery mounting bracket bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Battery tray installation bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Starter installation bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8

## **DESCRIPTION**

The starting system includes the battery, starter, solenoid switch, ignition switch, inhibitor switch (A/T), clutch pedal switch (M/T), ignition lock switch, connection wires and the battery cable.

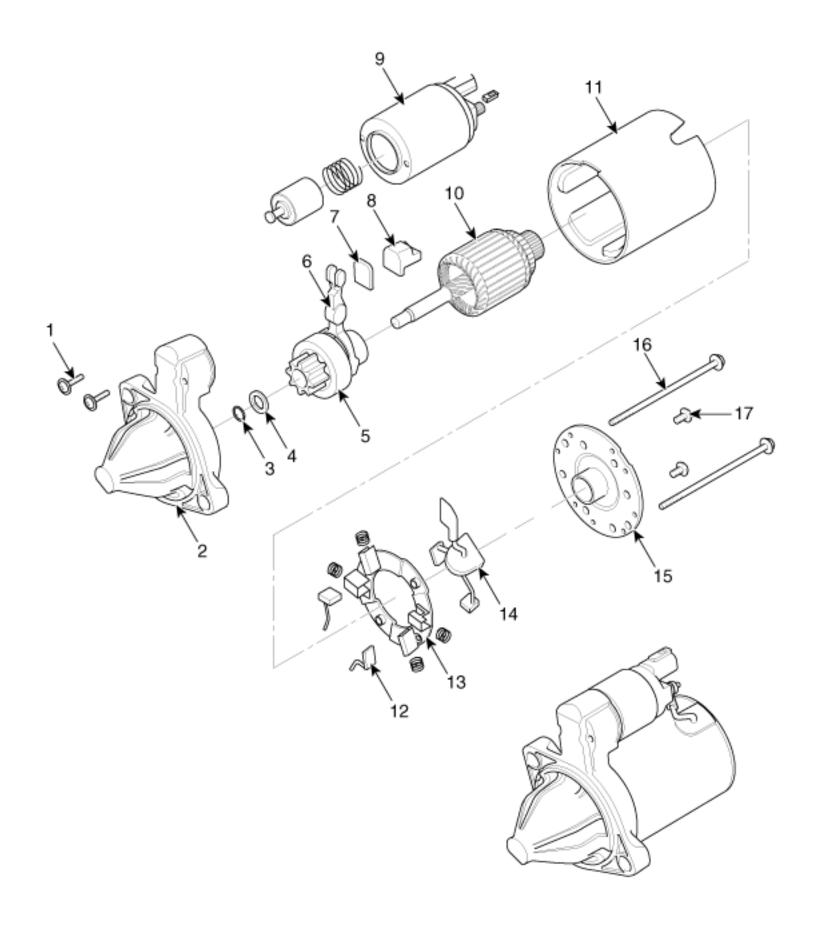
- When the ignition key is turned to the start position, current flows and energizes the starter motor's solenoid coil.
- The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear.
- The contacts close and the starter motor cranks.

In order to prevent damage caused by excessive rotation of the starter armature when the engine starts, the clutch pinion gear overruns.



- 1. Solenoid
- 2. Brush assembly
- 3. Armature
- 4. Overrun clutch

## **COMPONENTS**



- 1. Screw
- 2. Front housing
- 3. Stop ring
- 4. Stopper
- 5. Overunn clutch
- 6. Lever
- 7. Lever plate
- 8. Lever packing
- 9. Magnet switch assembly

- 10. Armature assembly
- 11. Yoke assembly
- 12. Brush (-)
- 13. Brush holder
- 14. Brush (+)
- 15. Rear bracket
- 16. Through bolt
- 17. Screw

2016 > G 1.2 MPI > G 1.2 MPI > Engine Electrical System > Starting System > Starting

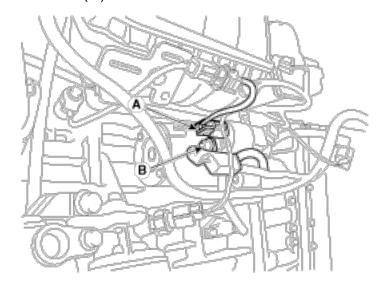
## **DESCRIPTION**

The starting system includes the battery, starter, solenoid switch, ignition switch, inhibitor switch (A/T), clutch pedal switch (M/T), ignition lock switch, connection wires and the battery cable.

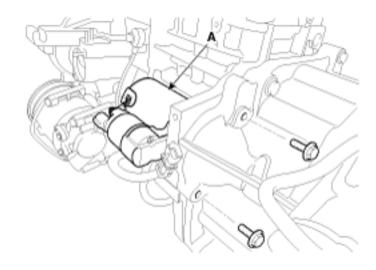
- When the ignition key is turned to the start position, current flows and energizes the starter motor's solenoid coil.
- The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear. The contacts close and the starter motor cranks.
- In order to prevent damage caused by excessive rotation of the starter armature when the engine starts, the clutch pinion gear overruns.

### **REMOVAL**

- 1. Disconnect the battery negative terminal.
- Remove the air duct and air cleaner assembly. (Refer to Engine Mechanical System - "Air Cleaner")
- 3. Disconnect the starter cable (B) from the B terminal on the solenoid then disconnect the connector from the S terminal (A).



4. Remove the 2 bolts holding the starter, then remove the starter (A).



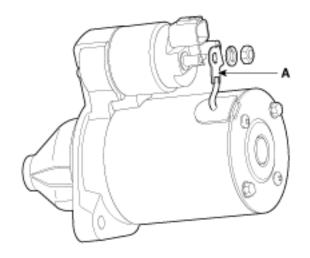
### **INSTALLATION**

1. Install in the reverse order of removal.

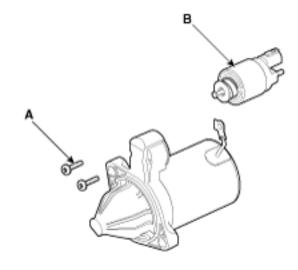
**Starter installation bolt:** 49.0 ~ 63.7 N.m (5.0 ~ 6.5 kgf.m, 36.2 ~ 47.0 lb-ft)

### **DISASSEMBLY**

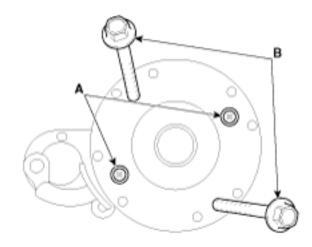
1. Disconnect the M-terminal (A) on the magnet switchassembly.



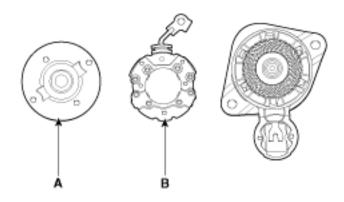
2. After loosening the 2 screws (A), detach the magnetswitch assembly (B).



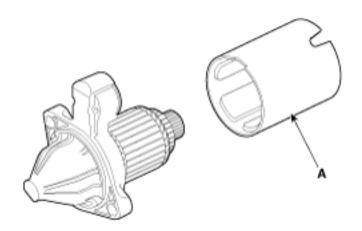
3. Loosen the brush holder mounting screw (A) and the trough bolts (B).



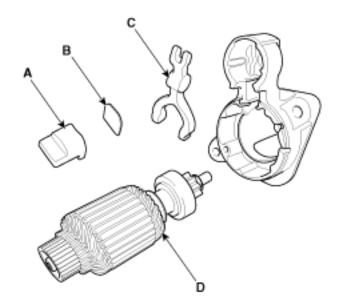
4. Remove the rear bracket (A) and brush holderassembly (B).



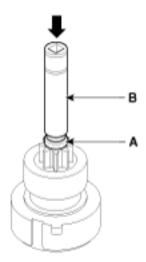
5. Remove the yoke (A).



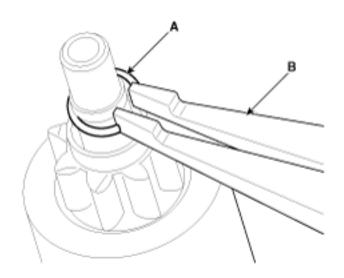
6. Remove the packing (A), lever plate (B), lever (C), armature (D).



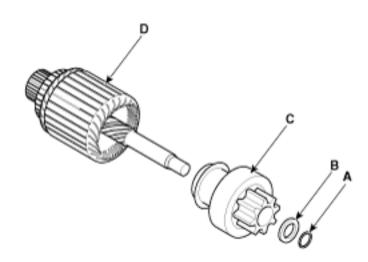
7. Press the stopper (A) using a socket (B).



8. After removing the stop ring (A) using stopper pliers (B).

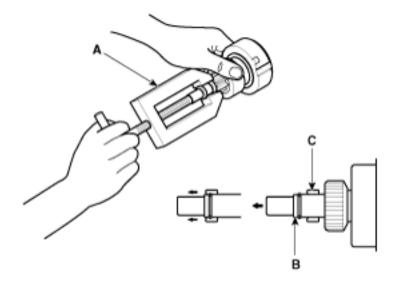


9. Remove the stop ring (B), stopper (A), overrunningclutch (C) and armature (D).



# i Information

• Using a suitable pulling tool (A), pull the overrunningclutch stopper (C) over the stop ring (B).



### **REASSEMBLY**

1. Reassemble in the reverse order of disassembly.

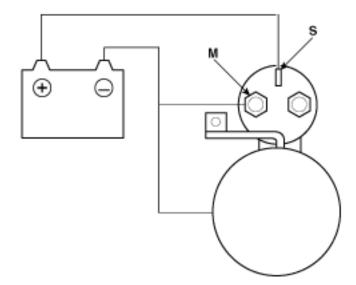
## **INSPECTION**

## **Starter Solenoid Inspection**

- 1. Disconnect the lead wire from the M-terminal of solenoid switch.
- 1. Connect the battery as shown. If the starter pinion pops out, it is working properly.

## **NOTICE**

• To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.

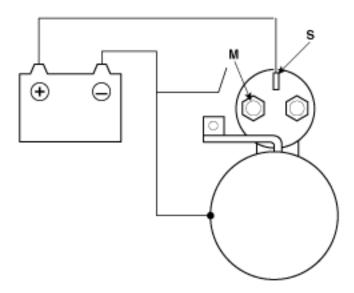


2. Disconnect the battery from the M terminal.

If the pinion does not retract, the hold-in coil is working properly.

### NOTICE

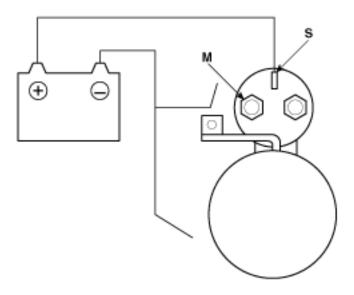
• To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.



3. Disconnect the battery also from the body. If the pinion retracts immediately, it is working properly.

## NOTICE

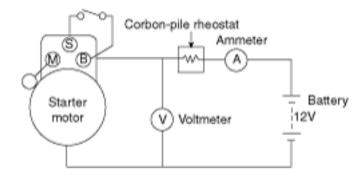
• To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.



## Free Running Inspection

4. Place the starter motor in a vise equipped with soft jaws and connect a fully-charged 12-volt battery to starter motor

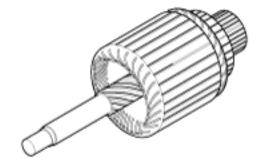
- as follows.
- 1. Connect a test ammeter (150-ampere scale) and carbon pile rheostats shown is the illustration.
- 2. Connect a voltmeter (15-volt scale) across starter motor.



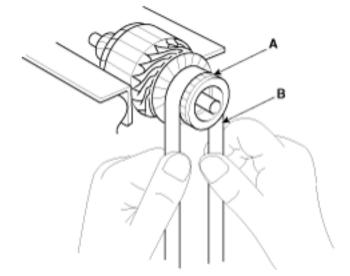
- 3. Rotate carbon pile to the off position.
- 4. Connect the battery cable from battery's negative post to the starter motor body.
- 5. Adjust until battery voltage shown on the voltmeter reads 11volts.
- 6. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely.

### **Armature**

- 7. Remove the starter.
- 1. Disassemble the starter as shown at the beginning of this procedure.
- 2. Inspect the armature for wear or damage from contact with the permanent magnet. If there is wear or damage, replace the armature.



3. Check the commutator (A) surface. If the surface is dirty or burnt, resurface with emery cloth or a lathe within the following specifications, or recondition with #500 or #600 sandpaper (B).



4. Check the commutator diameter. If the diameter is below the service limit, replace the armature.

#### **Commutator diameter**

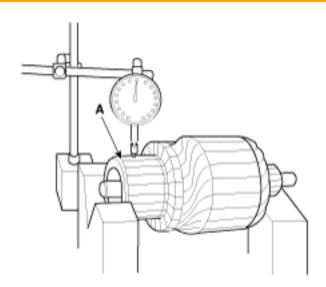
Standard (New) : 29.4 mm (1.1575 in) Service limit : 28.8 mm (1.1339 in)



- 5. Measure the commutator (A) runout.
  - If the commutator runout is within the service limit, check the commutator for carbon dust or brass chips between the segments.
  - If the commutator run out is not within the service limit, replace the armature.

#### **Commutator runout**

Standard (New): 0.05mm (0.0020in.) max Service limit: 0.10mm (0.0039in.) max

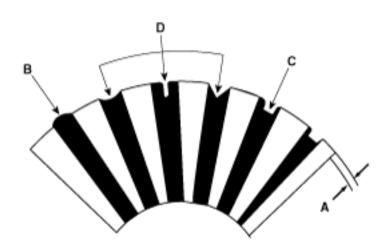


6. Check the mica depth (A). If the mica is too high (B), undercut the mica with a hacksaw blade to the proper depth. Cut away all the mica (C) between the commutator segments. The undercut should not be too shallow, too narrow, or v-shaped (D).

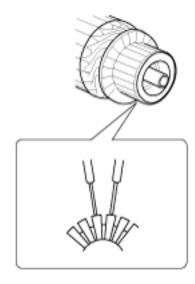
#### Commutator mica depth

Standard (New): 0.5 mm (0.0197 in.)

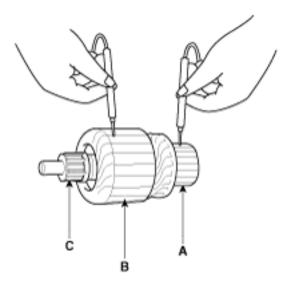
Limit: 0.2mm (0.0079 in.)



7. Check for continuity between the segments of the commutator. If an open circuit exists between any segments, replace the armature.



8. Check with an ohmmeter that no continuity exists between the commutator (A) and armature coil core (B), and between the commutator and armature shaft (C). If continuity exists, replace the armature.

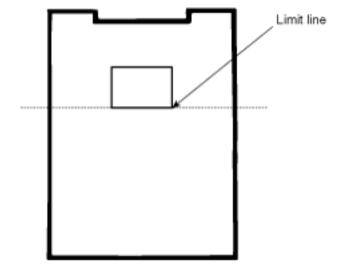


#### **Starter Brush**

9. Brushes that are worm out, or oil-soaked, should be replaced.

### **Bruch length**

Standard : 12.3 mm (0.4843 in) Service linit : 5.5 mm (0.2165 in)

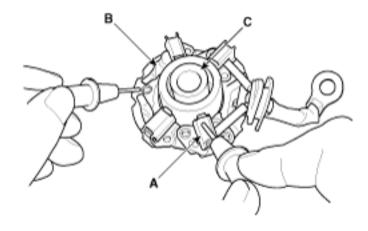


## NOTICE

• To seat new brushes, slip a strip of #500 or #600 sandpaper, with the grit side up, between the commutator and each brush, and smoothly rotate the armature. The contact surface of the brushes will be sanded to the same contour as the commutator.

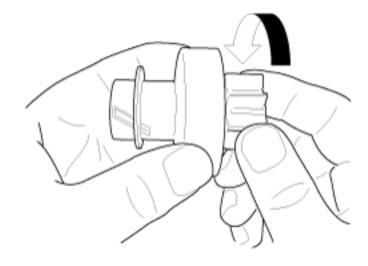
### **Starter Brush Holder**

1. Check that there is no continuity between the (+) brush holder (A) and (-) plate (B). If there is continuity, replace the brush holder assembly.



### **Overrunning Clutch**

- 1. Slide the overrunning clutch along the shaft. Replace it if does not slide smoothly.
- Rotate the overrunning clutch both ways.Does it lock in one direction and rotate smoothly in reverse? If it does not lock in either direction of it locks in both directions, replace it.



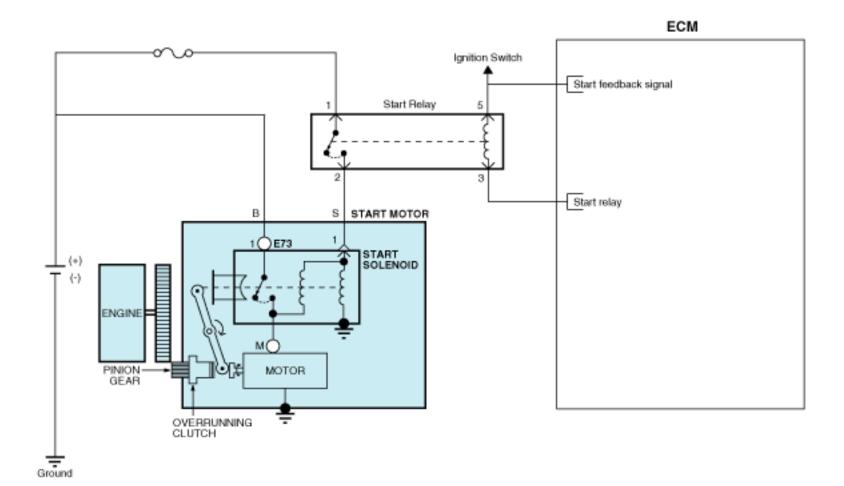
- 3. If the starter drive gear is worn or damaged, replace the overrunning clutch assembly. (the gear is not available separately)
  - Check the condition of the flywheel or torque converter ring gear if the starter drive gear teeth are damaged.

## **CLEANING**

- Do not immerse parts in cleaning solvent.
   Immersing the yoke assembly and/or armature will damage the insulation wipe these parts with a cloth only.
- 2. Do not immerse the drive unit in cleaning solvent.

  The overrun clutch is pre-lubricated at the factory and sol-vent will wash lubrication from the clutch.
- 3. The drive unit may be cleaned with a brush moistened with cleaning solvent and wiped dry with a cloth.

## **CIRCUIT DIAGRAM**



2016 > G 1.2 MPI > G 1.2 MPI > Engine Electrical System > Starting System > Starter > Specifications

# **SPECIFICATION**

## Starter

Item		Specification
Rated voltage		12 V, 0.9 kW
The number of pinion teeth		10
Performance	Ampere	Max. 58A
[No-load, 11.5 V]	Speed	Min. 3000 rpm

#### **TROUBLESHOOTING**

#### NOTICE

The battery must be in good condition and fully charged for this troubleshooting.

Disconnect the fuel pump fuse in the engine room fuse box. Turn the ignition switch to "START" at P or N shift lever position. (A/T) OK Turn the ignition switch to "START" while pressing the clutch pedal Starting system is OK. and the brake pedal. (M/T) Check if the engine is cranking normally. NG If pinion gear doesn't disengage from the ring gear when you release key, NG check for the following until you find the cause. Replace the starter Solenoid plunger and magnetic switch malfunction Dirty pinion gear or damaged overrunning clutch. OK Check the battery condition. (Positive/ Negative cable connection, OK Negative cable connection to the body, Engine ground cables, Starting system is OK. Starter "B" terminal connection and corrosion. After then try starting the engine again. NG Disconnect the connector from the S-terminal of solenoid. NG Connect the wire between solenoid B-terminal and solenoid S-terminal. Replace the starter Check if the engine is cranking normally. OΚ

Check the following items until you find the open circuit.

- Check the starter relay
- Check the wire and connectors between the fuse & relay box and the ignition switch
- Check the wire and connectors between the fuse & relay box and the starter.
- Check the ignition switch (Refer to Body Electrical System ignition switch)
- Check the key warning switch (Refer to Body Electrical System ignition switch)
- Check the inhibitor switch (A/T) (Refer to Automatic transaxle Inhibitor switch)
- Check the clutch switch (M/T) (Refer to Clutch system Clutch switch)
- Check the brake switch (M/T) (Refer to BR Brake switch)

### **THE MICRO 570 ANALYZER**

The Micro 570 Analyzer provides the ability to test the charging and starting systems, including the battery, starter and alternator.

# **A** CAUTION

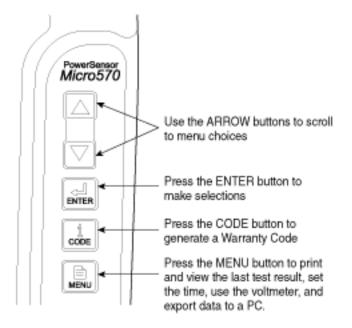
- \* Because of the possibility of personal injury, always use extreme caution and appropriate eye protection when working with batteries.
- \* When charging battery by test result, Battery must be fully charged.

To get accurate test result, battery surface voltage must have subsided ahead before test when you test battery after charged. (See following Battery Test Results)



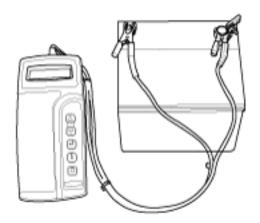
### Keypad

The Micro 570 button on the key pad provide the following functions:



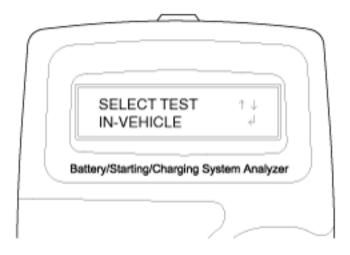
### **Battery Test Procedure**

- 1. Connect the tester to the battery.
  - Red clamp to battery positive (+) terminal.
  - Black clamp to battery negative (-) terminal.

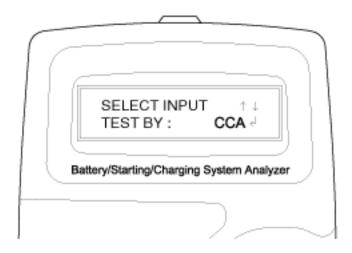


# **▲** CAUTION

- Connect clamps securely. If "CHECK CONNECTION" message is displayed on the screen, reconnect clamps securely.
- 2. The tester will ask if the battery is connected "IN-VEHICLE" or "OUT-OF-VEHICLE". Make your selection by pressing the arrow buttons; then press ENTER.

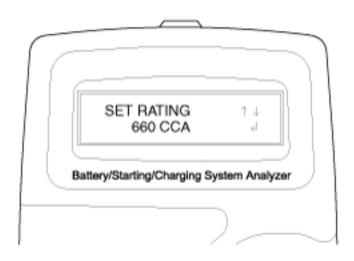


3. Select CCA and press the ENTER button.



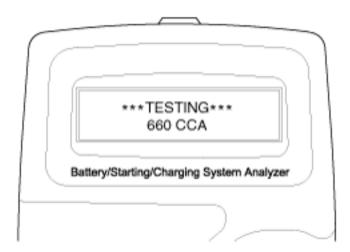
### NOTICE

- CCA: Cold cranking amps, is an SAE specification for cranking batteried at -0.4°F (-18°C).
- 4. Set the CCA value displayed on the screen to the CCA value marked on the battery label by pressing up and down buttons and press ENTER.



# NOTICE

- The battery ratings(CCA) displayed on the tester must be identical to the ratings marked on battery label.
- 5. The tester will conduct battery test.



6. The tester displays battery test results including voltage and battery ratings.

Refer to the following table and take the appropriate action as recommended by the Micro 570.



# **Battery Test Results**

Result On Printer	Remedy	
GOOD BATTERY	No action is required.	
GOOD RECHARGE	Battery is in a good state. Recharge the battery and use.  ** You have to follow instruction below when you charge battery and retest, otherwise test result can be inaccurate. (See 'Charge and Retest method after battery charge' below.)	
CHARGE & RETEST	Battery is not charged properly.	

	Charge and test the battery again.
	* You have to follow instruction below when you charge battery and retest, otherwise test result can be inaccurate. (See 'Charge and Retest method after battery charge' below.)
REPLACE BATTERY	Replace battery and recheck the charging system.
	<ul> <li>Improper connection between battery and vehicle cables may cause "REPLACE BATTERY". Retest the battery after removing cables and connecting the tester to the battery terminal directly prior to replacing the battery.</li> </ul>
BAD CELL-REPLACE	Charge and retest the battery.
	<ul> <li>If the Micro 570 recommends "REPLACE BATTERY", replace the battery and recheck the charging system.</li> </ul>

### [Charge and Retest method after battery charge]

#### **Battery charge**

Set battery charger to 'Auto Mode' (The Mode that charging current drops as the battery charges.) and charge battery until charging current down close to zero or the charger alerts you with an alarm when charge is complete. (Minimum charging time recommended: More than 3 hours with Auto Mode that explained above)

- If battery is not fully charged, battery surface voltage will be high while the amount of current charged (CCA) in battery is low. If you measure the battery under this condition, tester may misjudge that battery sulfation occurred because the amount of current in battery is too low in comparison with battery voltage.
  - \* Surface voltage: When battery is charged electrolyte temperature increases and chemical reaction become active resulting in an excessive increase of battery voltage.

It is known that it takes approximate one day to subside this increased surface voltage completely.

#### **Battery Test after charge**

Do not test battery right after the charge. Test battery after battery surface voltage has subsided as instructed in the following procedure.

- (1) When battery charge is complete, install the battery in the vehicle.
- (2) Put IG key to ON position and turn on head lamp with low beam, and wait 5 minutes. (Discharge for 5 minutes)
- (3) Turn off the head lamp and IG key, and wait 5 minutes. (Waiting for 5 minutes)
- (4) Remove +, cable from the battery and test battery.

# **▲** WARNING

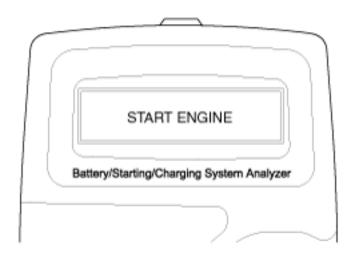
Whenever filing a claim for battery, the print out of the battery test results must be attached.

#### **Starter Test Procedure**

7. After the battery test, press ENTER immediately for the starter test.

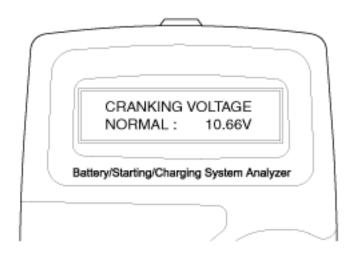


8. Start the engine.



9. Cranking voltage and starter test results will be displayed on the screen.

Refer to the following table and take the appropriate action as recommended by the Micro 570.



### **Starter Test Results**

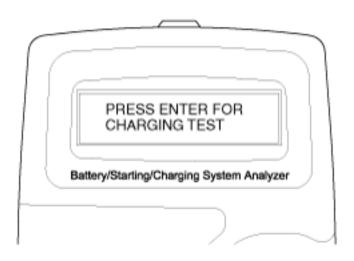
Result On Printer	Remedy	
CRANKING VOLTAGE NORMAL	System shows a normal starter draw.	
CRANKING VOLTAGE LOW	Cranking voltage is lower than normal level.  – Check starter.	
CHARGE BATTERY	The state of battery charge is too low to test.  - Charge the battery and retest.	
REPLACE BATTERY	Replace battery.      If the vehicle is not started though the battery condition of "GOOD BATTERY" is displayed, check wiring for open circuit, battery cable connection, starter and repair or replace as necessary.      If the engine does crank, check fuel system.	

### NOTICE

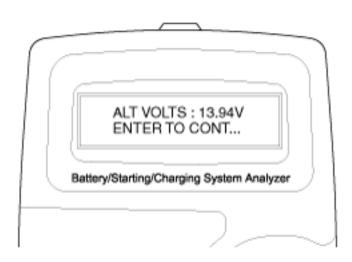
• When testing the vehicle with old diesel engines, the test result will not be favorable if the glow plug is not heated. Conduct the test after warming up the engine for 5 minutes.

### **Charging System Test Procedure**

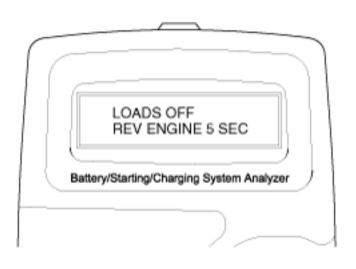
10. Press ENTER to begin charging system test.

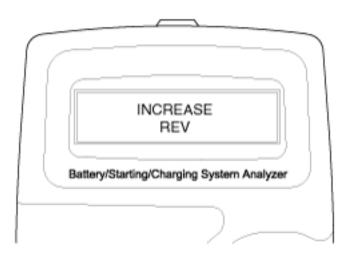


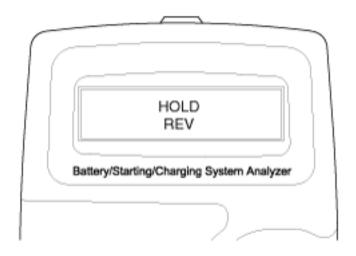
11. The tester displays the actual voltage of alternator. Press ENTER to continue.



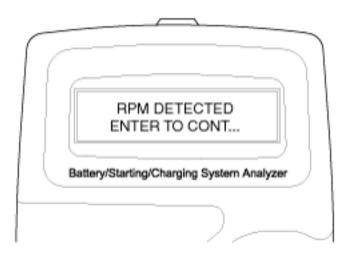
12. Turn off all electrical load and rev engine for 5 seconds with pressing the accelerator pedal. (Follow the instructions on the screen)



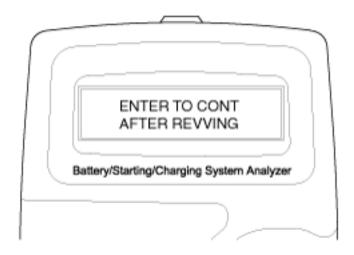




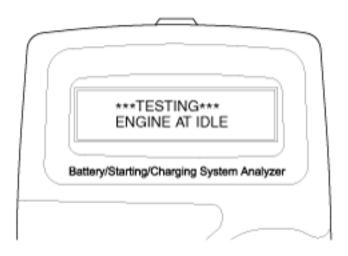
13. The message that engine RPM is detected will be displayed on the screen. Press ENTER to continue.

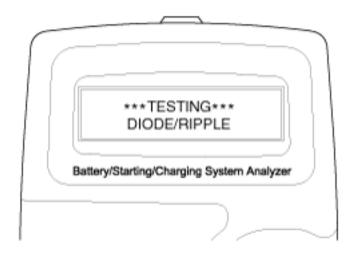


14. If the engine RPM is not detected, press ENTER after revving engine.

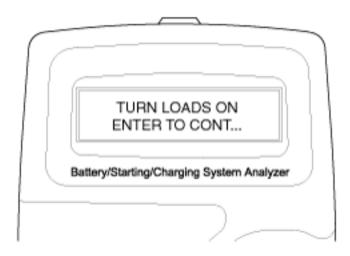


15. The tester will conduct charging system test during loads off.

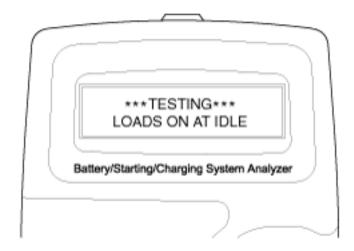




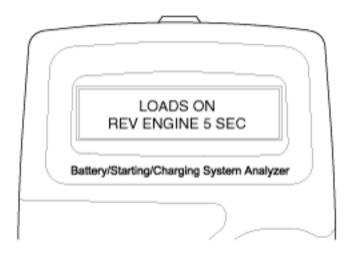
16. Turn on electrical loads (air conditioner, lamps, audio and etc). Press ENTER to continue.

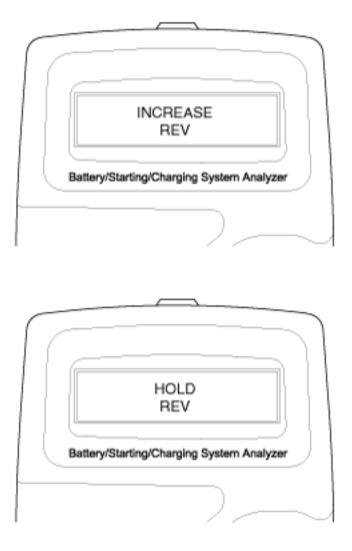


17. The tester will conduct charging system test during loads on.

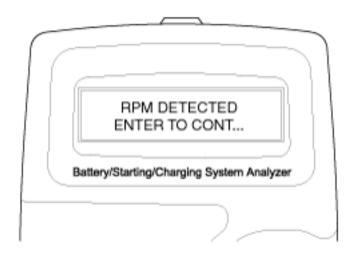


18. Rev engine for 5 seconds with pressing the accelerator pedal. (Follow the instructions on the screen)





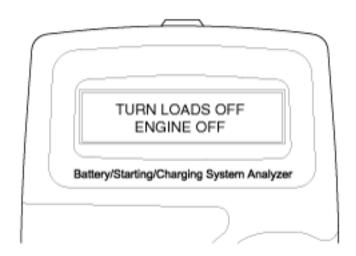
19. The message that engine RPM is detected will be displayed on the screen. Press ENTER to continue.



20. If the engine RPM is not detected, press ENTER after revving engine.

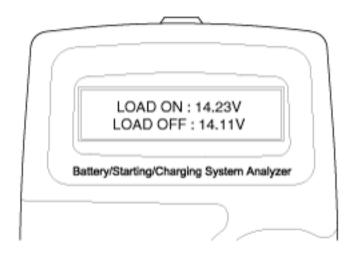


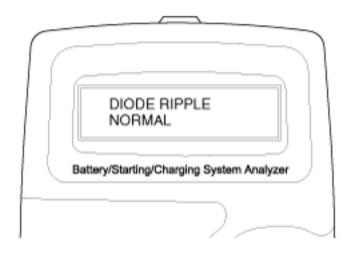
21. Turn off electrical loads (air conditioner, lamps, audio and etc). Turn the engine off.

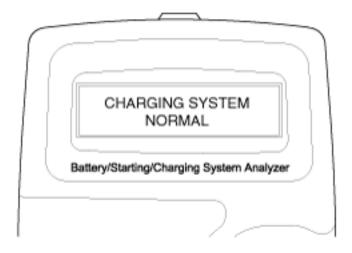


22. Charging voltage and charging system test results will be displayed on the screen.

Shut off engine end disconnect the tester clamps from the battery. Refer to the following table and take the appropriate action as recommended by the Micro 570.







# **Charging System Test Results**

Result On Printer	Remedy
CHARGING SYSTEM NORMAL	Charging system is normal.

/ DIODE RIPPLE NORMAL	
NO CHARGING VOLTAGE	Alternator does not supply charging current to battery.
	Check belts, connection between alternator and battery and replace belts or cable or alternator as necessary.
LOW CHARGING VOLTAGE	Alternator does not supply charging current to battery and electrical load to system fully.
	Check belts and alternator and replace as necessary.
HIGH CHARGING VOLTAGE	The voltage from alternator to battery is higher than normal limit during voltage regulating.
	Check connection and ground and replace regulator as necessary.
	Check electrolyte level in the battery.
EXCESS RIPPLE DETECTED	One or more diodes in the alternator is not functioning properly.  - Check alternator mounting and belts and replace as necessary.

# The MDX-670P Analyzer

The MDX-670P battery conductance and electrical system analyzer tests batteries as well as starting and charging systems for vehicle.

It displays the test results in seconds and features a built-in printer to provide a copy of the results.

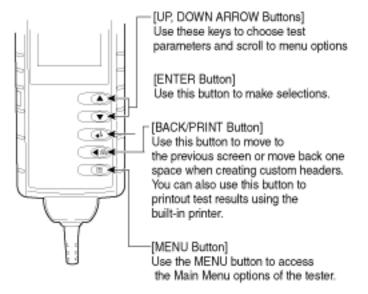


### **▲** CAUTION

- 1) Because of the possibility of personal injury, always use extreme caution and appropriate eye protection when working with batteries.
- 2) When charging battery by test result, Battery must be fully charged. To get accurate test result, battery surface voltage must have subsided ahead before test when you test battery after charged. (See following Battery Test Results)

### NOTICE

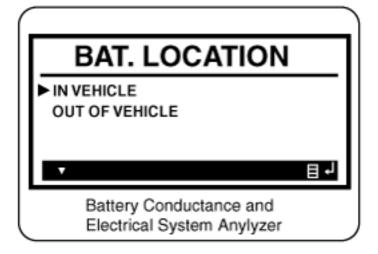
• When testing the vehicle with old diesel engines, the test result will not be favorable if the glow plug is not heated. Conduct the test after warming up the engine for 5 minutes.



1. Connect the red clamp to the positive (+) terminal and the black clamp to the negative (–) terminal.

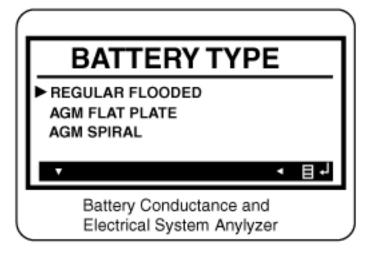
### NOTICE

- For a proper connection, rock the clamps back and forth. The tester requires that both sides of each clamp be firmly connected before testing. A poor connection will produce a CHECK CONNECTION or WIGGLE CLAMPS message. If the message appears, clean the terminals and reconnect the clamps.
- 2. Scroll to and select IN VEHICLE or OUT OF VEHICLE for a battery not connected to a vehicle.



### **NOTICE**

- Following an IN VEHICLE test you will be prompted to test the starting and charging systems.
- 3. Scroll to and select REGULAR FLOODED, AGM FLAT PLATE, or AGM SPIRAL where applicable.

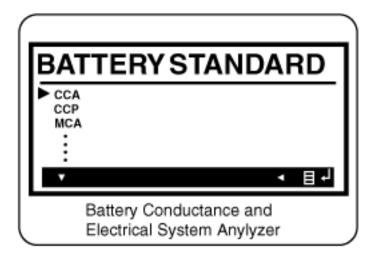


### NOTICE

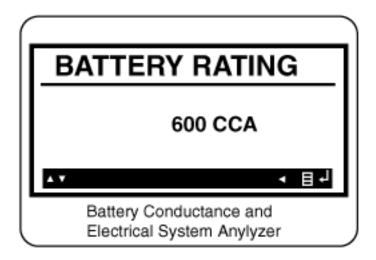
- If the vehicle equipped with ISG function, select the AGM FLAT PLATE.
- 4. Scroll to and select the battery's rating system.

### NOTICE

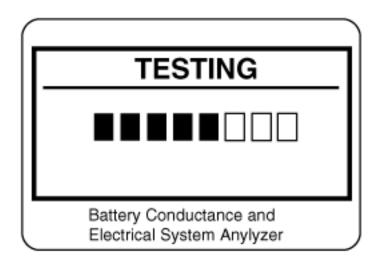
Mostly, the CCA value is marked on the battery label, but sometimes marked EN or SEA value. Select one
of them.



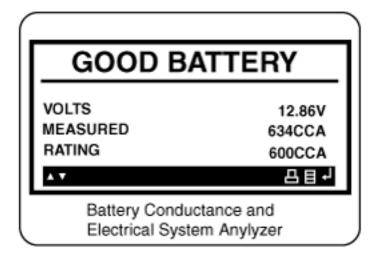
- CCA: Cold Cranking Amps, as specified by SAE. The most common rating for cranking batteries at 0 °F (–17.8 °C).
- EN: Europe-Norm
- SAE: Society of Automotive Engineers, the European labeling of CCA
- 5. Set the selected rating value displayed on the screen to the value marked on the battery label by pressing up and down arrow buttons.



6. Press ENTER to start test.



7. After several seconds the tester displays the decision on the battery's condition and the measured voltage. The tester also displays your selected battery rating and the rating units.



### **Battery Test Results**

Result On Printer	Remedy	
GOOD BATTERY	No action is required.	
GOOD RECHARGE	Battery is in a good state. Recharge the battery and use.  ** You have to follow instruction below when you charge battery and retest, otherwise test result can be inaccurate. (See 'Charge and Retest method after battery charge' below.)	
CHARGE & RETEST	Battery is not charged properly.  - Charge and test the battery again.  ** You have to follow instruction below when you charge battery and retest, otherwise tes result can be inaccurate. (See 'Charge and retest method after battery charge' below.)	
REPLACE BATTERY	Replace battery and recheck the charging system.  - Improper connection between battery and vehicle cables may cause "REPLACE BATTERY", retest the battery after removing cables and connecting the tester to the battery terminal directly prior to replacing the battery.	
BAD CELLREPLACE	Charge and retest the battery.  – If recommends "REPLACE BATTERY", replace the battery and recheck the charging system.	

# [Charge and Retest method after battery charge]

#### **Battery charge**

Set battery charger to 'Auto Mode' (The Mode that charging current drops as the battery charges.) and charge battery until charging current down close to zero or the charger alerts you with an alarm when charge is complete. (Minimum charging time recommended: More than 3 hours with Auto Mode that explained above)

- If battery is not fully charged, battery surface voltage will be high while the amount of current charged (CCA) in battery is low. If you measure the battery under this condition, tester may misjudge that battery sulfation occurred because the amount of current in battery is too low in comparison with battery voltage.
  - \* Surface voltage: When battery is charged electrolyte temperature increases and chemical reaction become active resulting in an excessive increase of battery voltage.

It is known that it takes approximate one day to subside this increased surface voltage completely.

### **Battery Test after charge**

Do not test battery right after the charge. Test battery after battery surface voltage has subsided as instructed in the following procedure.

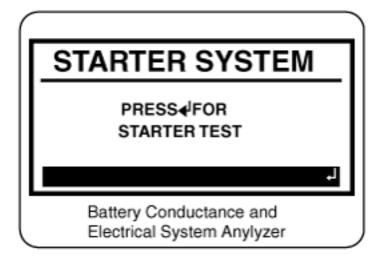
- (1) When battery charge is complete, install the battery in the vehicle.
- (2) Put IG key to ON position and turn on head lamp with low beam, and wait 5 minutes. (Discharge for 5 minutes)
- (3) Turn off the head lamp and IG key, and wait 5 minutes. (Waiting for 5 minutes)
- (4) Remove +, cable from the battery and test battery.

### NOTICE

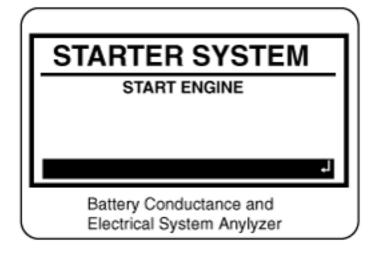
 For an in-vehicle test, the display alternates between the test results and the message "PRESS FOR STARTER TEST.

### **NOTICE**

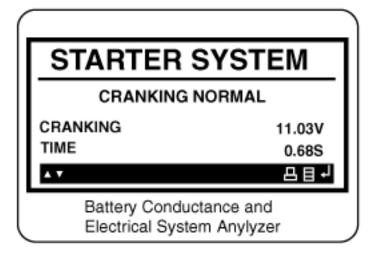
- Before starting the test, inspect the alternator drive belt. A belt that is glazed or worn, or lacks the proper tension, will prevent the engine from achieving the rpm levels needed for the test.
- 8. Press the ENTER button to proceed with the starter test.



9. Start the engine when prompted.



10. The tester displays the decision on the starter system, cranking voltage, and cranking time in milliseconds.



#### **Starter Test Results**

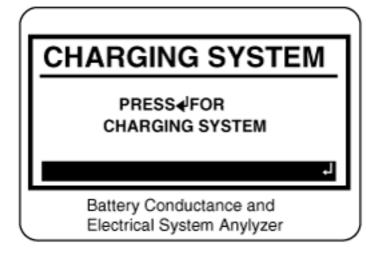
Result On Printer	Remedy	
CRANKING VOLTAGE NORMAL	System shows a normal starter draw.	
CRANKING VOLTAGE LOW	Cranking voltage is lower than normal level.  - Check starter.	
CHARGE BATTERY	The state of battery charge is too low to test.  - Charge the battery and retest.	
REPLACE BATTERY	Replace battery.  - If the vehicle is not started though the battery condition of "GOOD BATTERY" is displayed, check wiring for open circuit, battery cable connection, starter and repair or replace as necessary.	
	If the engine does crank, check fuel system.	

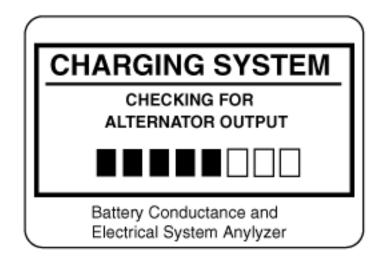
### NOTICE

• For an in-vehicle test, the display alternates between the test results and the message "PRESS FOR CHARGING TEST.

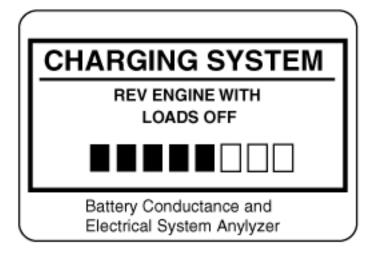
#### **Step 3: Charging System Test**

11. Press the ENTER button to proceed with the charging test.

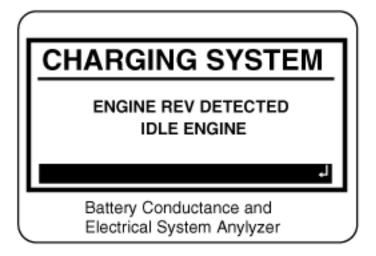




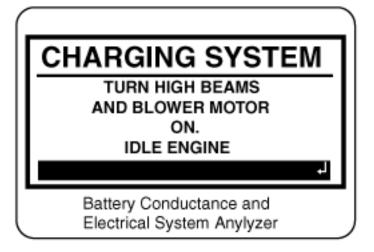
12. Rev the engine with loads off. (Following the on-screen prompts)



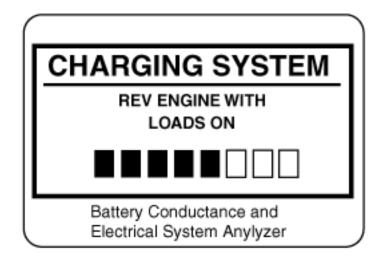
13. The message that engine RPM is detected will be displayed on the screen, idle the engine.



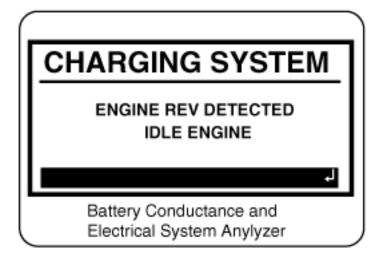
14. Turn on electrical loads (air conditioner, lamps, audio and etc). Press ENTER to continue.



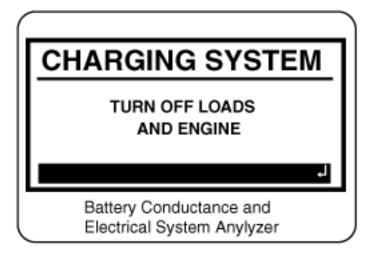
15. Turn on electrical loads (air conditioner, lamps, audio and etc). Press ENTER to continue.



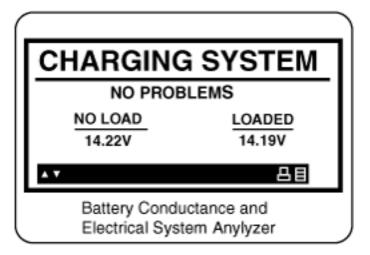
16. The message that engine RPM is detected will be displayed on the screen, idle the engine.



17. Turn off loads and engine.



18. The Charging System decision is displayed at the end of the procedure.



System is showing normal output from the alternator.	
No alternator output detected.	
Check all connections to and from the alternator, especially the connection to the battery. If the connection is loose or heavily corroded, clean or replace the cable and retest.	
<ul> <li>If the belts and connections are in good working condition, replace the alternator. (Older vehicles use external voltage regulators, which may require only replacement of the voltage regulator.)</li> </ul>	
Alternator does not supply charging current to battery and electrical load to system fully.	
Check belts and alternator and replace as necessary.	
The voltage from alternator to battery is higher than normal limit during voltage regulating.	
Check connection and ground and replace regulator as necessary.	
Check electrolyte level in the battery.	
The voltage from alternator to battery is higher than normal limit during voltage regulating.	
Check alternator mounting and belts and replace as necessary.	
The starter voltage is low and the battery is discharged. Fully charge the battery and repeat the starter system test.	
Battery must be replaced before the starting system can be tested.	

19. Press the BACK/PRINT button to print the test results or MENU to return to the Options Menu.

# **TROUBLESHOOTING**

# **Ignition System**

Symptom	Suspect Area	Remedy
Engine will not start or is hard to start (Cranks OK)	Ignition lock switch	Inspect ignition lock switch, or replace as required
	Ignition coil	Inspect ignition coil, or replace as required
	Spark plugs	Inspect spark plugs, or replace as required
	Ignition wiring disconnected or broken	Repair wiring, or replace as required
Rough idle or stalls	Ignition wiring	Repair wiring, or replace as required
	Ignition coil	Inspect ignition coil, or replace as required
Engine hesitates/poor acceleration	Spark plugs and spark plug cables	Inspect spark plugs / cable, or replace as required
	Ignition wiring	Repair wiring, or replace as required
Poor mileage	Spark plugs and spark plug cables	Inspect spark plugs / cable, or replace as required
	<u> </u>	

Charging System			
Symptom	Suspect Area	Remedy	
Charging warning indicator does not	Fuse blown	Check fuses	
light with ignition switch "ON" and engine off.	Light burned out	Replace light	
Grigino on.	Wiring connection loose	Tighten loose connection	
	Electronic voltage regulator	If light turns off, replace voltage regulator.	
Charging warning indicator does not	Drive belt loose or worn	Adjust belt tension or replace belt	
go out with engine running. (Battery requires frequent recharging)	Battery cable loose, corroded or worn	Inspect cable connection, repair or replace cable	
	Electronic voltage regulator or alternator	If light turns off, replace voltage regulator or alternator	
	Wiring	Repair or replace wiring	
Overcharge	Electronic voltage regulator	If light turns off, replace voltage regulator.	
	Voltage sensing wire	Repair or replace wiring	
Discharge	Drive belt loose or worn	Adjust belt tension or replace belt	
	Wiring connection loose or short circuit	Inspect wiring connection, repair or replace wiring	
	Electronic voltage regulator or	If light turns off, replace voltage	

alternator

regulator or alternator

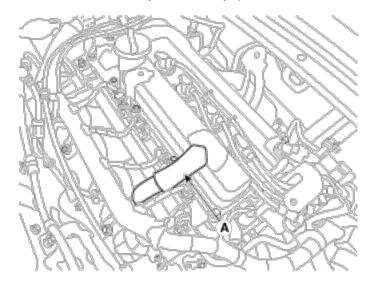
Poor grounding	Inspect ground or repair	
Worn battery	Replace battery	

# **Starting System**

Symptom	Suspect Area	Remedy
Engine will not crank	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn out	Repair or replace cables
	Transaxle range switch (Vehicle with automatic transaxle only)	Refer to AT group-automatic transaxle
	Fuse blown	Replace fuse
	Starter motor faulty	Replace
	Ignition switch faulty	Replace
Engine cranks slowly	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn out	Repair or replace cables
	Starter motor faulty	Replace
Starter keeps running	Starter motor faulty	Replace
	Ignition switch	Replace
Starter spins but engine will not crank	Short in wiring	Repair or replace wiring
	Pinion gear teeth broken or starter motor	Replace
	Ring gear teeth broken	Replace fly wheel or torque converter

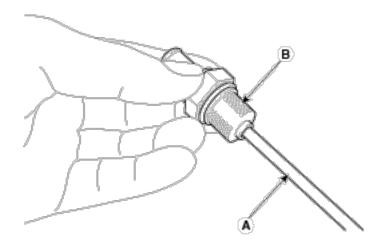
# **REMOVAL**

1. Disconnect the vapor hose (A) and then remove the PCV valve (B).



### **INSPECTION**

1. Insert a thin stick (A) into the PCV valve (B) from the threaded side to check that the plunger moves.



### NOTICE

If the plunger does not move (PCV valve is clogged), clean or replace the valve.

### **INSTALLATION**

1. Install in the reverse order of removal.

#### **PCV Valve installation:**

7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.8 ~ 8.7 lb-ft)

# **OPERATION PRINCIPLE**

Engine Condition	Not Running	Idling or Decelerating	Normal Operation	Accelerating and High Load
Vacuum in Intake Manifold	0	High	Moderate	Low
PCV Valve	Close	Slightly Open	Properly Open	Fully Open
Blow-by Gas Flow	0	Small	Medium	Large
Schematic Diagram	Intake Manifold	Intake Manifold	Intake Manifold	Intake Manifold
			•	

# **INSPECTION**

- 1. After disconnecting the vapor hose from the PCV valve, remove the PCV valve.
- 2. Reconnect the PCV valve to the vapor hose.
- 3. Run the engine at idle, and put a finger on the open end of the PCV valve and make sure that intake manifold vacuum can be felt.

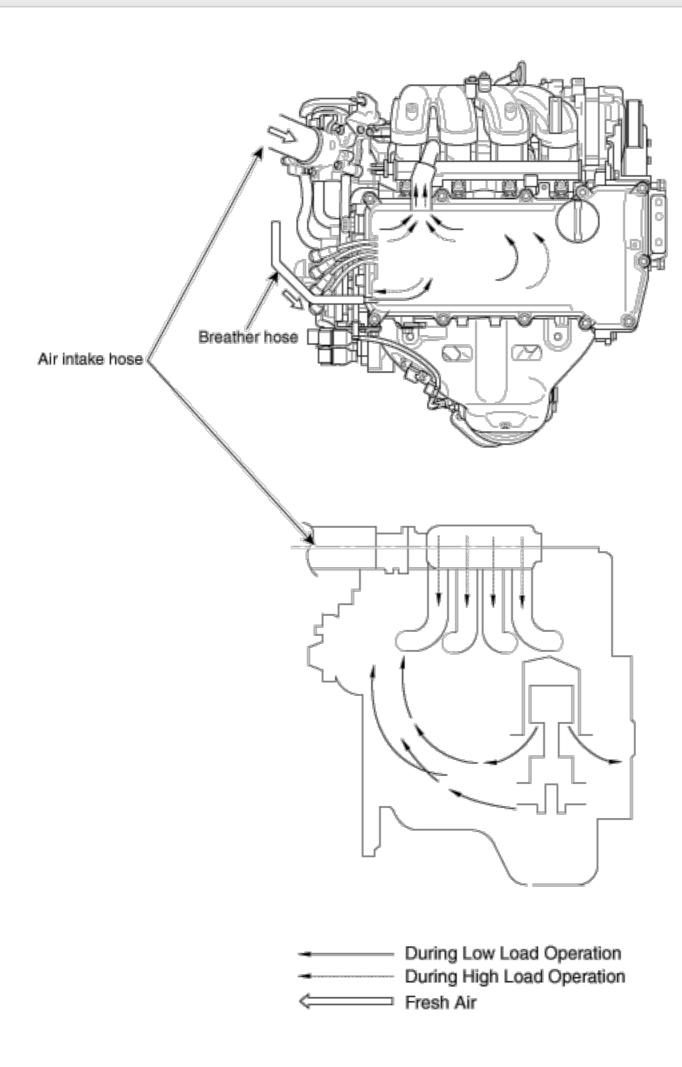
# NOTICE

The plunger inside the PCV valve will move back and forth at vacuum.



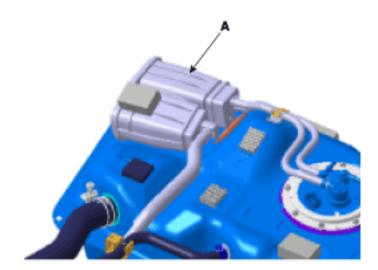
4. If the vacuum is not felt, clean or replace the vapor hose.

# **SCHEMATIC DIAGRAM**



### **REMOVAL**

- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- 2. Lift the vehicle.
- Remove the fuel tank.(Refer to Engine Control / Fuel System "Fuel Tank")
- 4. Remove the canister (A).



#### **INSPECTION**

- 1. Check for the following items visually.
  - Cracks or leakage of the canister
  - Loose connection, distortion, or damage of the vapor hose/tube



A: Canister ↔ Atmosphere

B: Canister ↔ Intake Manifold

C: Canister ↔ Fuel Tank

### **INSTALLATION**

1. Install in the reverse order of removal.

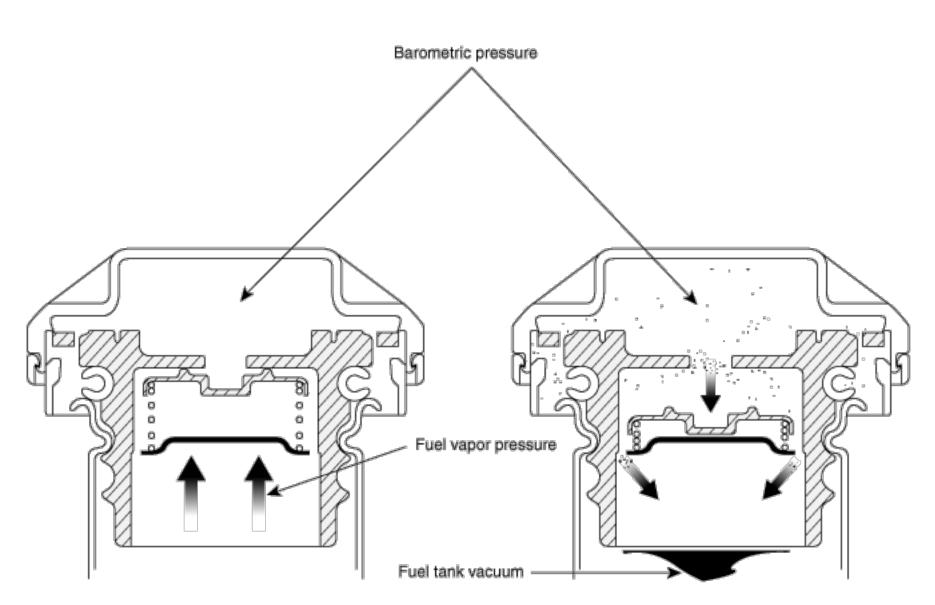
2016 > G 1.2 MPI > G 1.2 MPI > Emission Control System > Evaporative Emission Control System > Description and Operation

# **DESCRIPTION**

Evaporative Emission Control System prevents fuel vapor stored in fuel tank from vaporizing into the atmosphere. When the fuel evaporates in the fuel tank, the vapor passes through vent hoses or tubes to the canister filled with charcoal and the canister temporarily holds the vapor in the charcoal. If ECM determines to draw the gathered vapor into the combustion chambers during certain operating conditions, it will use vacuum in intake manifold to move it.

### **DESCRIPTION**

A ratchet tightening device on the threaded fuel filler cap reduces the chances of incorrect installation, which would seal the fuel filler. After the gasket on the fuel filler cap and the filler neck flange contact each other, the ratchet produces a loud clicking noise indicating the seal has been set.



When fuel tank is under pressure.

When fuel tank is under vacuum.

#### **INSPECTION**

### [System Inspection]

- 1. Disconnect the vapor hose from the throttle body and connect a vacuum pump to the nipple on the throttle body.
- 2. Check the following points with applying vacuum using the vacuum pump.
  - · At Cold Engine [Engine Coolant Temperature < 60°C(140°F)]

Engine Operating Condition	Applied Vacuum	Result	
Idle	0.5kgf/cm <sup>2</sup>	Vacuum is held	
3,000rpm	(50kPa,7.3psi)		

· At Warmed Engine [Engine Coolant Temperature > 80°C(176°F)]

Engine Operating Condition	Applied Vacuum	Result
Idle	0.5kgf/cm² (50kPa,7.3psi)	Vacuum is held
Within 3 minutes after engine start at 3,000 rpm	Try to applyvacuum	Vacuum is released
In 3 minutes after engine start at 3,000 rpm	0.5kgf/cm² (50kPa,7.3psi)	Vacuum will be held momentarily, after which, it will be released

# [PCSV Inspection]

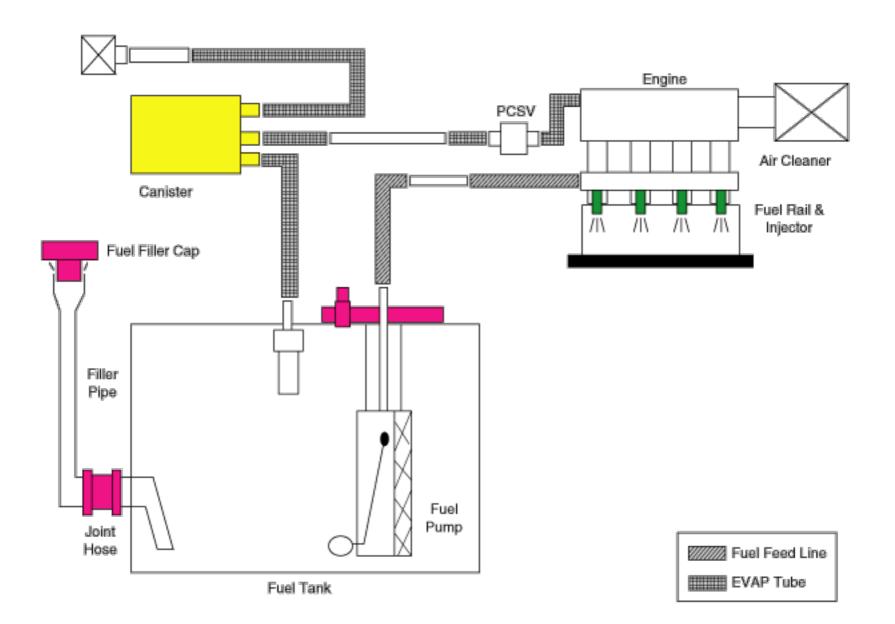
- 1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
- 2. Disconnect the PCSV connector.
- 3. Disconnect the vapor hose which is connected with the intake manifold from the PCSV.
- 4. After connecting a vacuum pump to the nipple, apply vacuum.
- 5. With the PCSV control line grounded, check valve operation when applying battery voltage to the PCSV or not.

Battery Voltage	Valve	Vacuum	
Connected	Open	Released	
Disconnected	Close	Maintained	

6. Measure the coil resistance of the PCSV.

**Specification:**  $14.0 \sim 18.0 \Omega [20^{\circ}C(68^{\circ}F)]$ 

### **SCHEMATIC DIAGRAM**



#### Canister

Canister is filled with charcoal and absorbs evaporated vapor in fuel tank. The gathered fuel vapor in canister is drawn into the intake manifold by the ECM/PCM when appropriate conditions are set.

### Purge Control Solenoid Valve (PCSV)

Purge Control Solenoid Valve (PCSV) is installed in the passage connecting canister and intake manifold. It is a duty type solenoid valve and is operated by ECM/PCM signal.

To draw the absorbed vapor into the intake manifold, the ECM/PCM will open the PCSV, otherwise the passage remains closed.

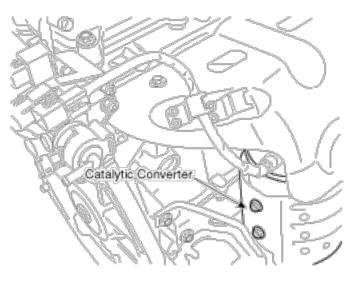
### Fuel Filler Cap

A ratchet tightening device on the threaded fuel filler cap reduces the chances of incorrect installation, which would seal the fuel filler. After the gasket on the fuel filler cap and the fill neck flange contact each other, the ratchet produces a loud clicking noise indicating the seal has been set.

2016 > G 1.2 MPI > G 1.2 MPI > Emission Control System > Exhaust Emission Control System Catalytic Converter > Description and Operation

# **DESCRIPTION**

The catalytic converter of the gasoline engine is a three way catalyst. It oxidizes carbon monoxide and hydrocarbons (HC), and separates oxygen from the oxides of nitrogen (NOx).



#### **DESCRIPTION**

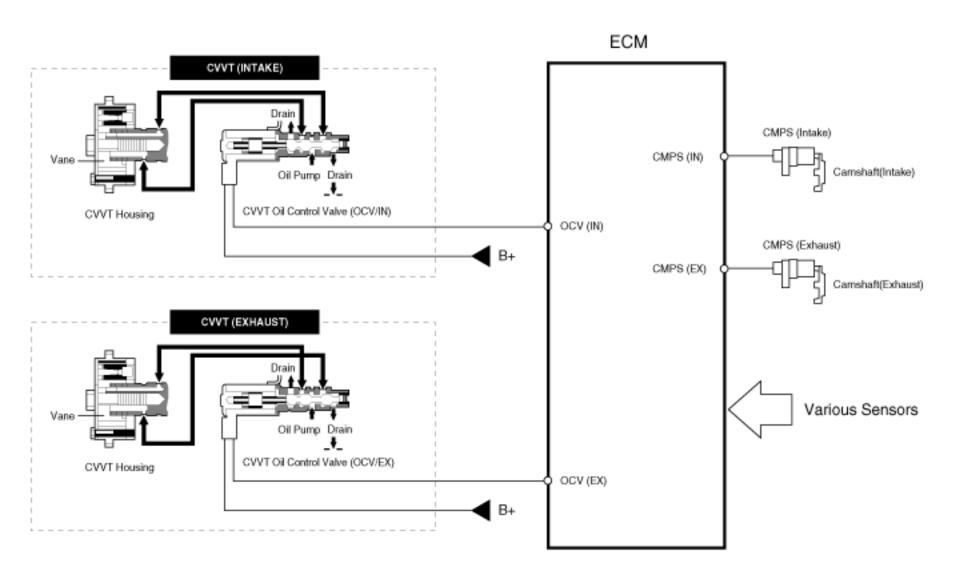
Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load.

By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NOx, HC) and improves engine performance through reduction of pumping loss, internal EGR effect, improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.

This system consist of

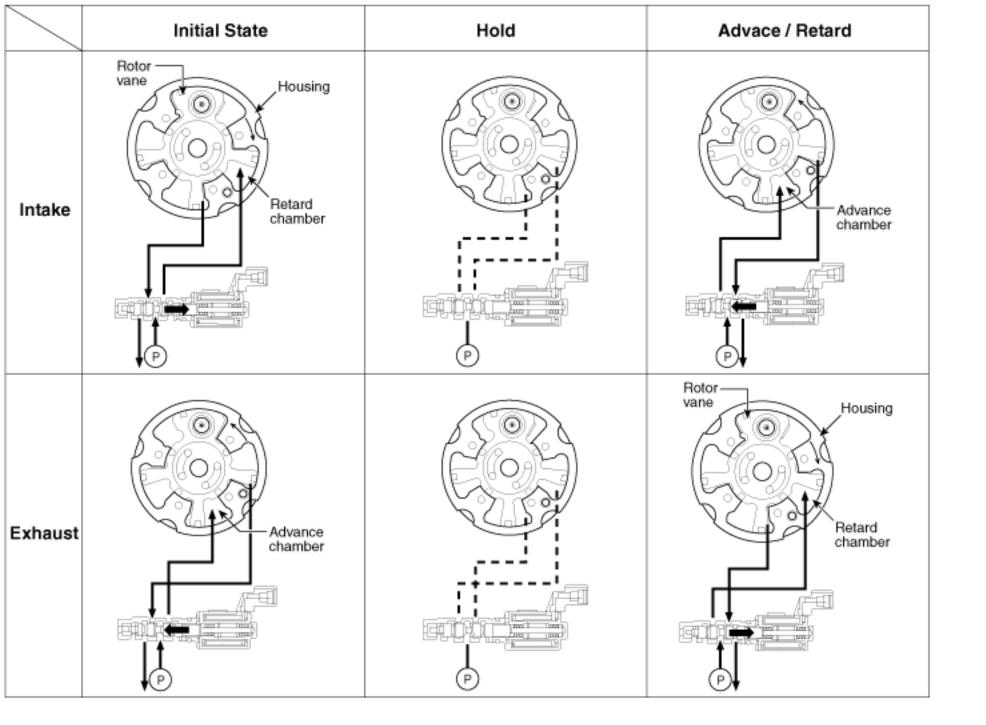
- the CVVT Oil Control Valve (OCV) which supplies the engine oil to the cam phaser or runs out the engine oil from the cam
  phaser in accordance with the ECM PWM (Pulse With Modulation) control signal,
- the CVVT Oil Temperature Sensor (OTS) which measures the engine oil temperature,
- and the Cam Phaser which varies the cam phase by using the hydraulic force of the engine oil.

The engine oil getting out of the CVVT oil control valve varies the cam phase in the direction (Intake Advance/Exhaust Retard) or opposite direction (Intake Retard/Exhaust Advance) of the engine rotation by rotating the rotor connected with the camshaft inside the cam phaser.

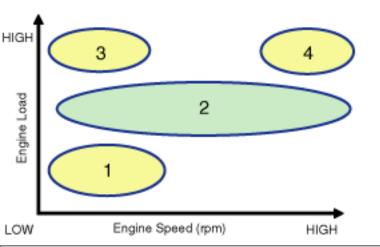


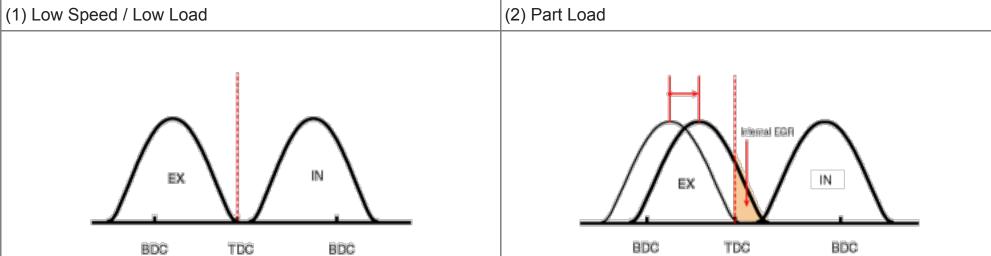
#### **OPERATION PRINCIPLE**

The CVVT has the mechanism rotating the rotor vane with hydraulic force generated by the engine oil supplied to the advance or retard chamber in accordance with the CVVT oil control valve control.



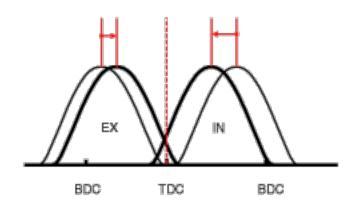
# [CVVT SYSTEM MODE]

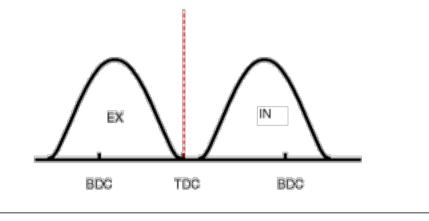




(3) Low Speed / High Load

(4) High Speed / High Load





Deixing	Exhaust Valve		Intake Valve		
Driving Condition	Valve Timing	Effect	Valve Timing	Effect	
(1) Low Speed /Low Load	Completely Advance	* Valve Under-lap * Improvement of combustion stability	Completely Retard	* Valve Under-lap  * Improvement of combustion stability	
(2) Part Load	Retard	* Increase of expansion work * Reduction of pumping loss * Reduction of HC	Retard	* Reduction of pumping loss	
(3) Low Speed /High Load	Retard	* Increase of expansion work	Advance	* Prevention of intake back flow (Improvement of volumetric efficiency)	
(4) High Speed /High Load	Advance	* Reduction of pumping loss	Retard	* Improvement of volumetric efficiency	

### **DESCRIPTION**

Exhaust emissions (CO, HC, NOx) are controlled by a combination of engine modifications and the addition of special control components.

Modifications to the combustion chamber, intake manifold, camshaft and ignition system form the basic control system. These items have been integrated into a highly effective system which controls exhaust emissions while maintaining good drivability and fuel economy.

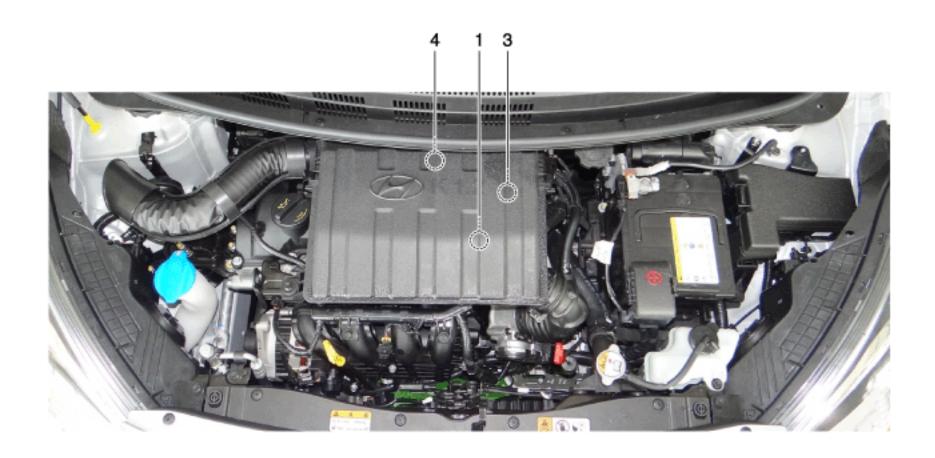
### Air/Fuel Mixture Control System [Multiport Fuel Injection (MFI) System]

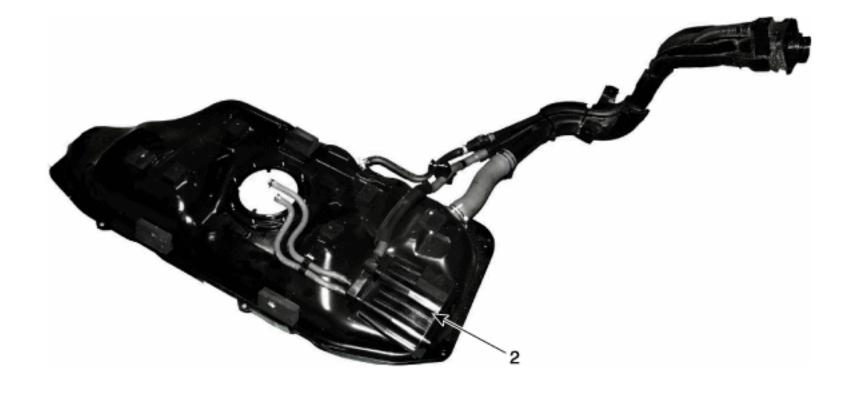
The MFI system is a system which uses the signals from the heated oxygen sensor to activate and control the injector installed in the manifold for each cylinder, thus precisely regulating the air/fuel mixture ratio and reducing emissions.

This in turn allows the engine to produce exhaust gases of the proper composition to permit the use of a three way catalyst. The three way catalyst is designed to convert the three pollutants (1) hydrocarbons (HC), (2) carbon monoxide (CO), and (3) oxides of nitrogen (NOx) into harmless substances. There are two operating modes in the MFI system.

- 1. Open Loop air/fuel ratio is controlled by information programmed into the ECM.
- 2. Closed Loop air/fuel ratio is adjusted by the ECM based on information supplied by the oxygen sensor.

### **COMPONENTS LOCATION**

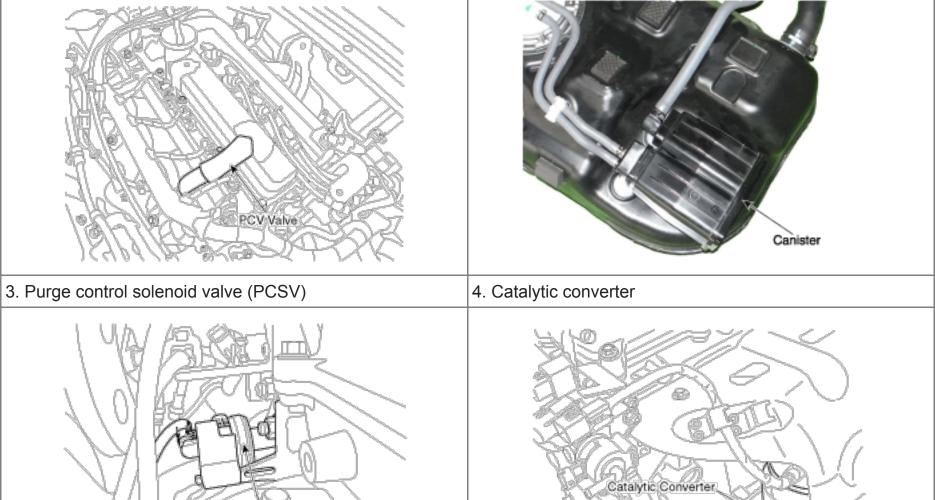




- 1. PCV valve
- 2. Canister

- 3. Purge control solenoid valve (PCSV)
- 4. Catalytic converter (WCC)

1. PCV valve 2. Canister



PCSV

### **DESCRIPTION**

Emissions control system consists of the three major systems.

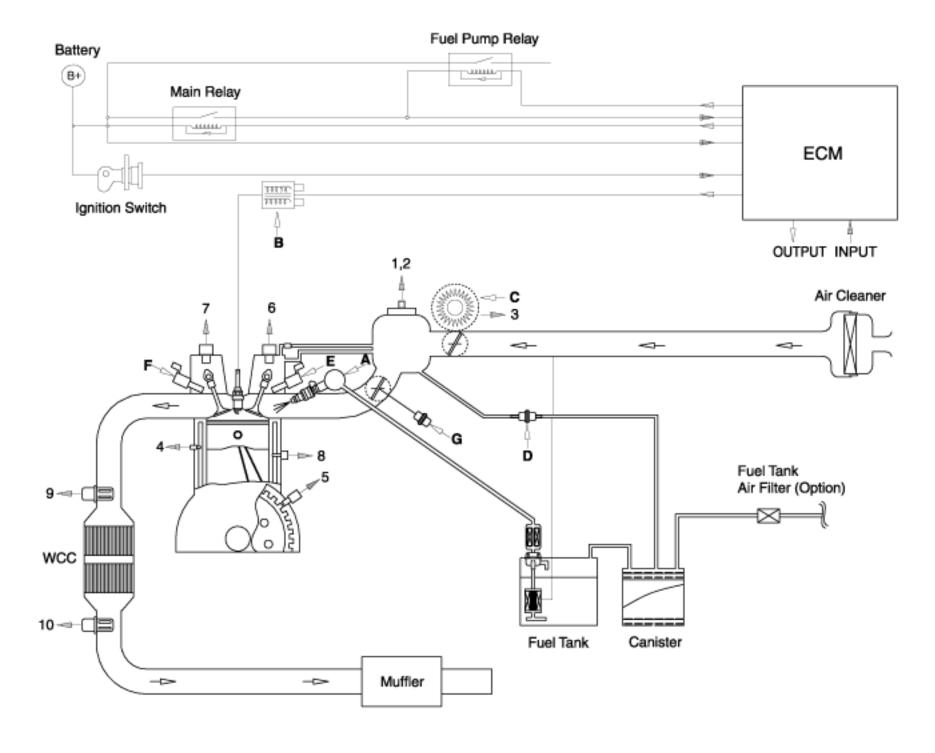
- Crankcase emission control system prevents blow-by gas from going into the atmosphere. This system burns these gases after moving them to the intake manifold (Closed Crankcase Ventilation Type).
- Evaporative emission control system prevents evaporative gas going into the atmosphere. This system burns the gases at appropriate engine operating condition after gathering it in the canister.
- Exhaust emission control system converts the three pollutants hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) into harmless substances by using the 3-way catalytic converter.

#### **SCHEMATIC DIAGRAM**

- Manifold Absolute Pressure Sensor (MAPS)
- 2. Intake Air Temperature Sensor (IATS)
- 3. Throttle Position Sensor (TPS) [integrated into ETC Module]
- 4. Engine Coolant Temperature Sensor (ECTS)
- 5. Crankshaft Position Sensor (CKPS)
- 6. Camshaft Position Sensor (CMPS) [Bank 1 / Intake]
- 7. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust]
- 8. Knock Sensor (KS)
- 9. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1]
- 10. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]
- Accelerator Position Sensor (APS)
- A/C Pressure Transducer (APT)
- · Ignition Switch Signal
- · Battery Power Signal
- · Vehicle Speed Signal
- Inhibitor Switch Signal
- Brake Switch Signal



- A. Injector
- B. Ignition Coil
- C. ETC Motor [integrated into ETC Module]
- D. Purge Control Solenoid Valve (PCSV)
- E. CVVT Oil Control Valve (OCV) [Bank 1 / Intake] F. CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust]
- G. Vaiable Intake Solenoid (VIS) Valve
- · Main Relay
- · Fuel Pump Relay
- · A/C Control
- Self Diagnosis



# **SPECIFICATIONS**

Purge control solenoid valve (PCSV)

Item	Specification	
Coil resistance (Ω)	14.0 ~ 18.0 [20°C(68°F)]	

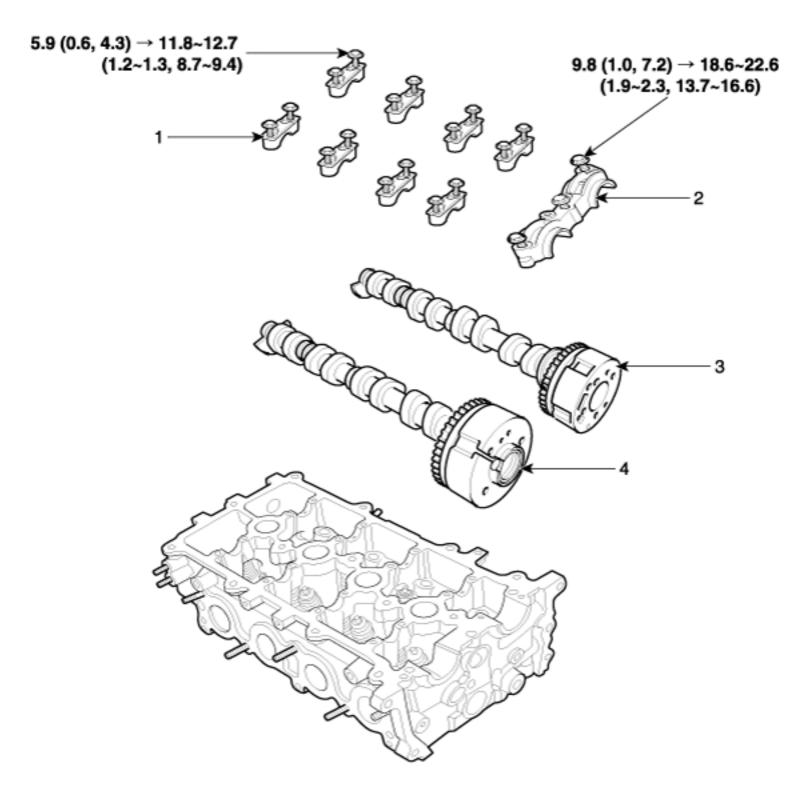
# **TIGHTENING TORQUES**

Item	kgf.m	N.m	lb-ft
Positive crankcase ventilation (PCV) valve installation	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7

# **TROUBLESHOOTING**

Symptom	Suspect area
Engine will not start or hard to start	Vapor hose damaged or disconnected
Engine hard to start	Malfunction of the purge control solenoid valve
Dough idle or angine stelle	Vapor hose damaged or disconnected
Rough idle or engine stalls	Malfunction of the PCV valve
Rough idle	Malfunction of the evaporative emission control system
Excessive oil consumption	Positive crankcase ventilation line clogged

### **COMPONENTS**



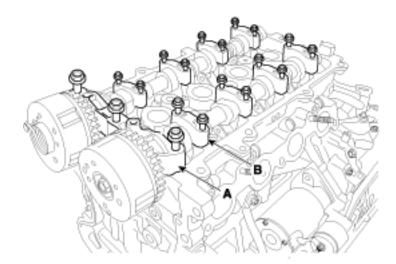
Torque: N.m (kgf.m, lb-ft)

- 1. Camshaft bearing cap
- 2. Front camshaft bearing cap

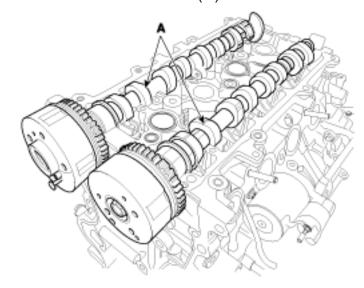
- 3. Intake CVVT & camshatf assembly
- 4. Exhaust CVVT & camshaft assembly

# **REMOVAL**

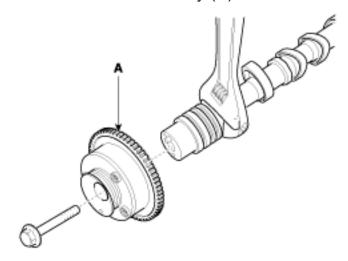
- Remove the timing chain.
   (Refer to Timing System "Timing Chain")
- 2. Remove the front camshaft bearing cap (A) and the camshaft bearing caps (B).

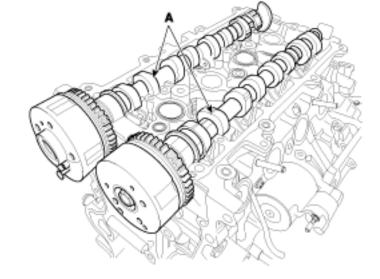


3. Remove the cam shafts (A).



4. Remove the CVVT assembly (A) from the camshaft.





#### **INSPECTION**

### Camshaft

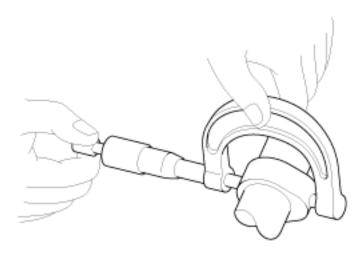
1. Inspect cam lobes.

Using a micrometer, measure the cam lobe height.

Cam height

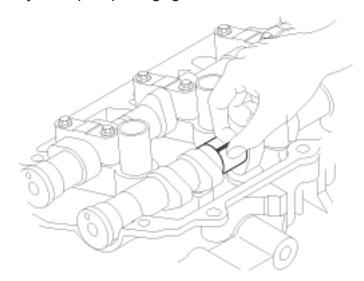
Intake: 36.4183 mm (1.4337 in)

Exhaust (1.25L): 36.1543 mm (1.4233 in) Exhaust (1.20L): 35.7730 mm (1.4068 in)



If the cam lobe height is less than standard, replace the camshaft.

- 2. Inspect the camshaft journal clearance.
  - (1) Clean the bearing caps and camshaft journals.
  - (2) Place the camshafts on the cylinder head.
  - (3) Lay a strip of plastigage across each of the camshaft journals.



(4) Install the front camshaft bearing cap (A) and the camshaft bearing cap (B) as following method with specified

torque.

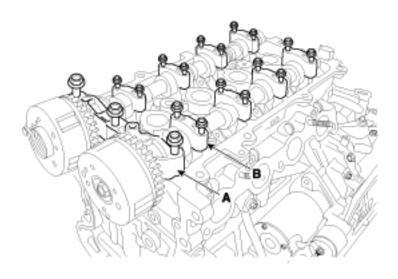
### **Tightening torque**

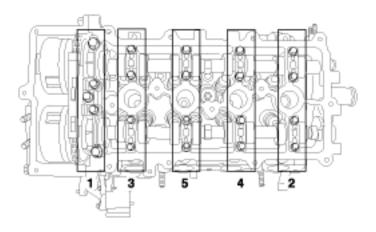
#### Step 1

A: 9.8 N.m (1.0 kgf.m, 7.2 lb-ft) B: 5.9 N.m (0.6 kgf.m, 4.3 lb-ft)

Step 2

A: 18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft) B: 11.8 ~ 13.7 N.m (1.2 ~ 1.4 kgf.m, 8.7 ~ 10.1 lb-ft)





### NOTICE

Do not turn the camshaft.

- (5) Remove the bearing caps.
- (6) Measure the plastigage at its widest point.

#### Camshaft bearing oil clearance

Intake :  $0.027 \sim 0.057 \text{ mm} (0.0010 \sim 0.0022 \text{ in})$ Exhaust :  $0.027 \sim 0.057 \text{ mm} (0.0010 \sim 0.0022 \text{ in})$ 

Camshaft journal outer diameter

Intake / Exhaust No.1: 36.464 ~ 36.478 mm (1.4356 ~ 1.4361 in) Intake / Exhaust No.2 ~ 5 : 22.964 ~ 22.978 mm (0.9040 ~ 0.9046 in)

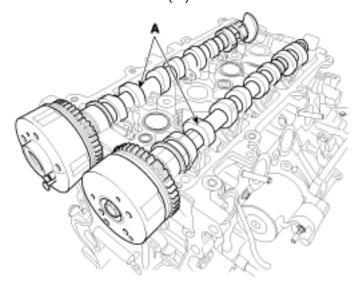
#### Camshaft journal bore inner diameter

Intake / Exhaust No.1: 36.505 ~ 36.521 mm (1.4372 ~ 1.4378 in) Intake / Exhaust No.2 ~ 5 : 23.005 ~ 23.021 mm (0.9057 ~ 0.9060 in)

If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

- (7) Completely remove the plastigage.
- (8) Remove the camshafts.
- 3. Inspect the camshaft end play.

(1) Install the camshafts (A).



(2) Install the front camshaft bearing cap (A) and the camshaft bearing cap (B) as following method with specified torque.

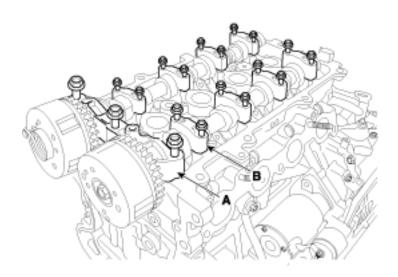
#### **Tightening torque**

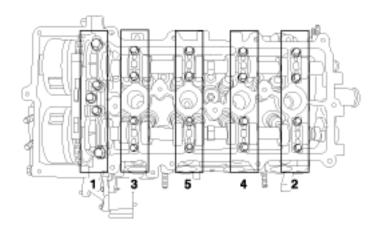
#### Step 1

A: 9.8 N.m (1.0 kgf.m, 7.2 lb-ft) B: 5.9 N.m (0.6 kgf.m, 4.3 lb-ft)

#### Step 2

A: 18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft) B: 11.8 ~ 13.7 N.m (1.2 ~ 1.4 kgf.m, 8.7 ~ 10.1 lb-ft)





# NOTICE

Do not turn the camshaft.

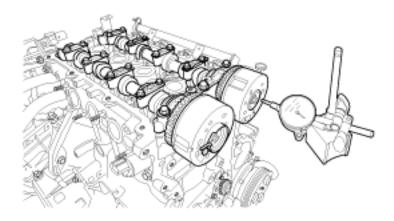
When cam caps are installed, arrows on the top of caps must point to out side of engine.

(3) Using a dial indicator, measure the end play while moving the camshaft back and forth.

### Camshaft end play

Intake: 0.1 ~ 0.2 mm (0.0039 ~ 0.0078 in)

Exhaust:  $0.1 \sim 0.2 \text{ mm} (0.0039 \sim 0.0078 \text{ in})$ 

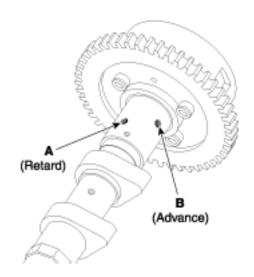


If the end play is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

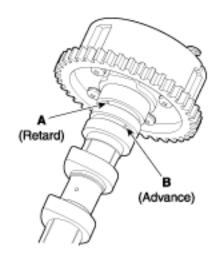
(4) Remove the camshafts.

# CVVT Assembly

- 1. Inspect CVVT assembly.
  - (1) Clamp the camshaft using a vise. Be careful not to damage the cam lobes and journals in the vise.
  - (2) Check that the CVVT is locked by turning it clockwise or counterclockwise. It must not rotate.
  - (3) Intake CVVT : Seal one of the two advance holes in the camshaft journal with tape. Exhaust CVVT : Seal one of the two retard holes in the camshaft journal with tape. **[Intake]**



### [Exhaust]



(4) Intake CVVT : Apply approx. 150kPa (1.5kgf/cm 21psi) of compressed air into the unsealed advance hole to release the lock.

Exhaust CVVT : Apply approx. 150kPa (1.5kgf/cm, 21psi) of compressed air into the unsealed retard hole to release the lock.



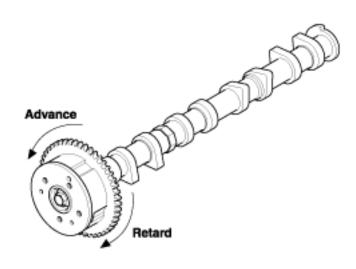
Cover the oil paths with a piece of cloth when applying compressed air to prevent oil from spraying.

(5) Intake CVVT: With compressed air applied, rotate the CVVT into the advance direction (counterclockwise) within its phasing range and check that the CVVT turns smoothly.

Exhaust CVVT: With compressed air applied, rotate the CVVT into the retard direction (clockwise) and check that the CVVT turns smoothly.

#### **CVVT** phasing range

Intake :  $25^{\circ} \pm 1^{\circ}$  (from the most retarded position to the most advanced position) Exhaust :  $20^{\circ} \pm 1^{\circ}$  (from the most advanced position to the most retarded position)



(6) Intake CVVT : Rotate the CVVT into the most retarded position (clockwise) and then check that the CVVT is locked.

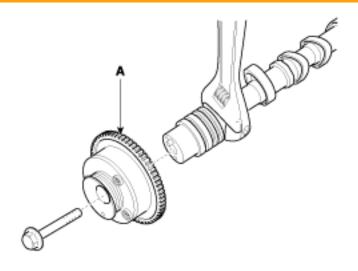
Exhaust CVVT: Rotate the CVVT into the most advanced position (counterclockwise) and then check that the CVVT is locked.

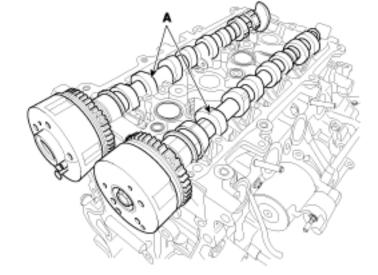
# **INSTALLATION**

1. Install the CVVT assembly (A) to the camshaft.

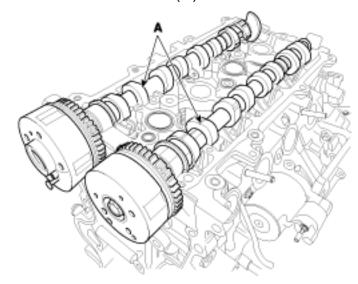
#### **Tightening torque:**

63.7 ~ 73.5 N.m (6.5 ~ 7.5 kgf.m, 47.0 ~ 54.2 lb-ft)





2. Install the cam shafts (A).



3. Install the front camshaft bearing cap (A) and the camshaft bearing caps (B) as following method with specified torque.

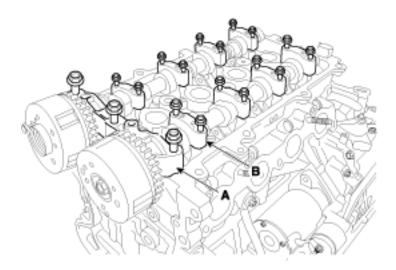
### **Tightening torque**

#### 1st step

A: 9.8 N.m (1.0 kgf.m, 7.2 lb-ft) B: 5.9 N.m (0.6 kgf.m, 4.3 lb-ft)

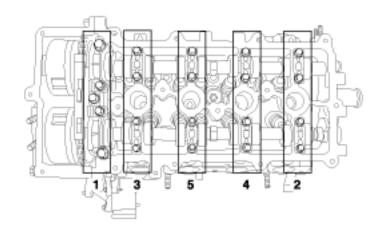
2nd step

A: 18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft) B: 11.8 ~ 13.7 N.m (1.2 ~ 1.4 kgf.m, 8.7 ~ 10.1 lb-ft)



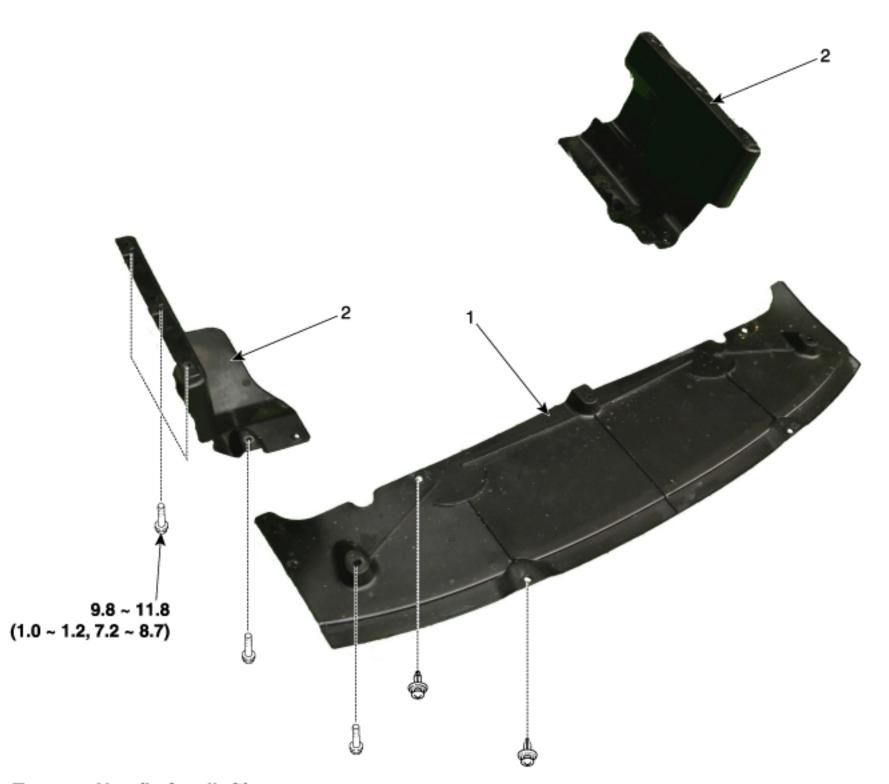
# NOTICE

Arrow on the top of cap must to outside of engine.



4. Install the other parts in the reverse order of removal.

# **COMPONENTS**



Torque : N.m (kgf.m, lb-ft)

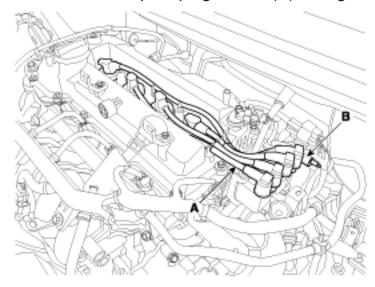
1. Under cover 2. Side cover

# **COMPRESSION PRESSURE INSPECTION**

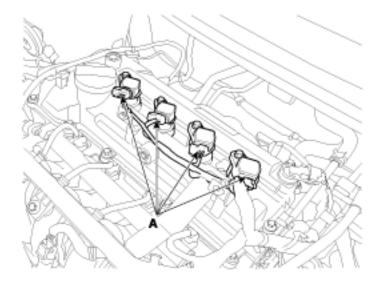
# NOTICE

If there is lack of power, excessive oil consumption or poor fuel economy, measure te compression pressure.

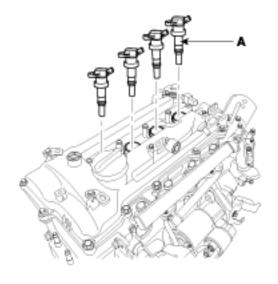
- 1. Start the engine and allow to warm up to operating temperature. (about five minutes) Stop the engine.
- Remove the air cleaner assembly. (Refer to Engine and Transaxle Assembly)
- 3. Disconnect the spark plug cables (A) and ignition coil connector. (Non-ISG type)



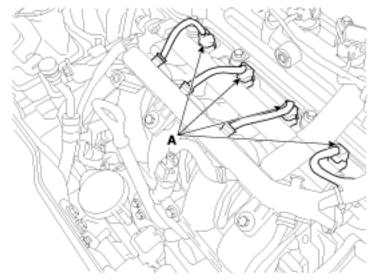
4. Disconnect the ignition coil connectors (A). (ISG type)



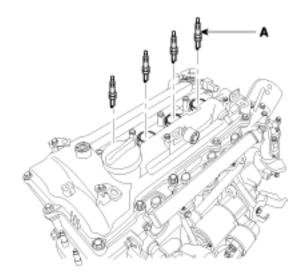
5. Remove the ignition coils (A). (ISG type)



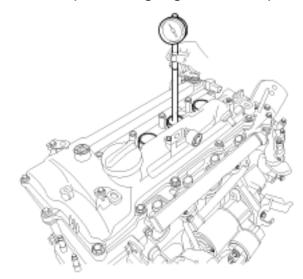
6. Disconnect the injector connectors (A).



7. Remove the four spark plugs (A) using a 16mm sparkplug wrench.



- 8. Check the cylinder compression pressure.
  - (1) Insert a compression gauge into the spark plug hole.



- (2) Fully open throttle.
- (3) While cranking the engine, measure the compression pressure.

# NOTICE

Always use a fully charged battery to obtain engine speed of 250rpm or more.

(4) Repeat step (1) through (3) for each cylinder.

# NOTICE

This measurement must be done in as short atime as possible

#### **Compression pressure:**

1,667 kPa (17.0 kg/cm<sup>2</sup>, 241 psi)

#### Minimum pressure:

1,470 kPa (15.0 kg/cm<sup>2</sup>, 213 psi)

#### Difference between each cylinder:

98 kPa (1.0 kg/cm², 14 psi) or less

- (5) If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat step (1) through (3) for cylinders with low compression.
  - If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
  - If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.
- 9. Reinstall the spark plugs.

### Tightening torque:

14.7 ~ 24.5 N.m (1.5 ~ 2.5 kgf.m, 10.8 ~ 18.1 lb-ft)

- 10. Connect the injector connectors.
- 11. Connect the ignition coil connector and the spark plug cables. (Non-ISG type)
- 12. Install the ignition coil. (ISG type)

#### **Tightening torque:**

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

- 13. Connect the ignition coil connectors. (ISG type)
- 14. Some DTC's may exist after the inspection test and may need to be manually cleard with GDS.

#### REPLACEMENT AND AIR BLEEDING

## **▲** WARNING

Never remove the radiator cap when the engine is hot. Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

### **▲** CAUTION

When pouring engine coolant, be sure to shut the relay box lid and not to let coolant spill on the electrical parts or the paint. If any coolant spills, rinse it off immediately.

- 1. Make sure the engine and radiator are cool to the touch.
- 2. Loosen the drain plug (A), and drain the coolant.

#### NOTICE

Remove the radiator cap to speed draining.



- 3. Tighten the radiator drain plug (A) securely.
- 4. After draining engine coolant the reservoir tank, clean the tank.
- 5. Fill the radiator with water through the radiator cap and tighten the cap.

### NOTICE

To most effectively bleed the air, pour the water slowly and press on the upper/lower radiator hoses.

- 6. Start the engine and allow to come to normal operating temperature. Wait for the cooling fans to turn on several times. Accelerate the engine to aid in purging trapped air. Shut engine off.
- 7. Wait until the engine is cool.
- 8. Repeat steps 1 to 7 until the drained water runs clear.
- 9. Fill fluid mixture with coolant and water (45~50%) (except for North America, Europe and China: 55~60%) slowly through the radiator cap. Push the upper/lower hoses of the radiator so as bleed air easily.

### NOTICE

- Use only genuine antifreeze/coolant.
- For best corrosion protection, the coolant concentration must be maintained year-round at 55% (except for North America, Europe and China: 45%) minimum.
   Coolant concentrations less than 55% (except for North America, Europe and China: 45%) may not provide sufficient protection against corrosion or freezing.
- Coolant concentrations greater then 60% will impair cooling efficiency and are not recommended.

# **▲** CAUTION

- · Do not mix different brands of antifreeze / coolants.
- Do not use additional rust inhibitors or antirust products; they may not be compatible with the coolant.
- Start the engine and run until coolant circulates.
   When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
- 11. Repeat 11 until the cooling fan 3~5 times and bleed air sufficiently out of the cooling system.
- 12. Install the radiator cap and fill the reservoir tank to the "MAX" (or "F") line with coolant.
- 13. Run the vehicle under idle until the cooling fan operates 2~3 times.
- 14. Stop the engine and wait coolant gets cool.
- 15. Repeat 10 to 15 until the coolant level doesn't fall any more, bleed air out of the cooling system.

### NOTICE

It takes time to bleed out all the air in the cooling system. Refill coolant when coolant gets cool completely, when recheck the coolant level in the reservoir tank for 2~3 days after replacing coolant.

#### **Coolant capacity:**

4.8 L (1.27 U.S.gal., 5.07 U.S.qt., 4.22 lmp.qt.)

### **REMOVAL**

# Cooling fan assembly

- Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly "Engine Room Under Cover")
- 2. Disconnect the battery negative terminal.
- 3. Disconnect the cooling fan connector (A).



4. Remove the automatic transaxle fluid cooler hoses (A). [A/T type only]



5. Disconnect the mounting pin and then remove the cooling fan (A).



6. Install in the reverse order of removal.

### Resistor

1. Disconnect the wire harness connector (A) and the fan motor connector (B).



2. Remove the resistor (A) from the cooling fan shroud.

# Tightening torque:

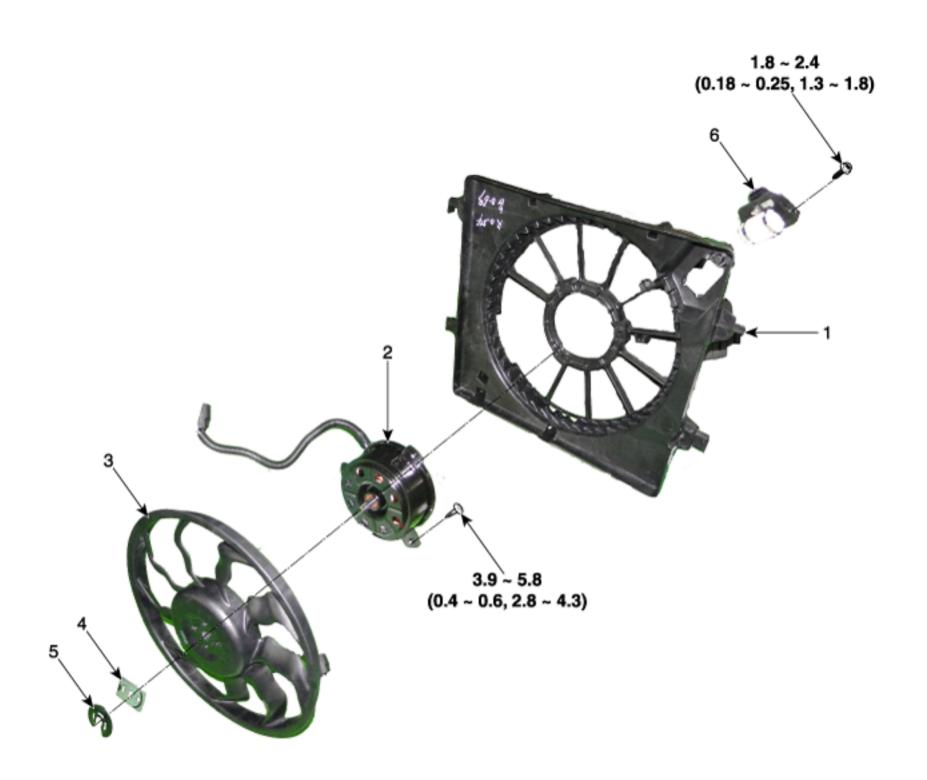
1.8 ~ 2.4 N.m (0.18 ~ 0.25 kgf.m, 1.3 ~ 1.8 lb-ft)



3. Install in the reverse order of removal.

# ng System > Cooling Fan >

# **COMPONENTS**



# Torque: N.m (kgf.m, lb-ft)

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- 2. Fan motor
- 3. Cooling fan

- 4. Torque washer
- 5. Retainer
- 6. Resistor

# **REMOVAL**

- 1. Disconnect the over flow hose (A).
- 2. Remove the reservoir tank (B).

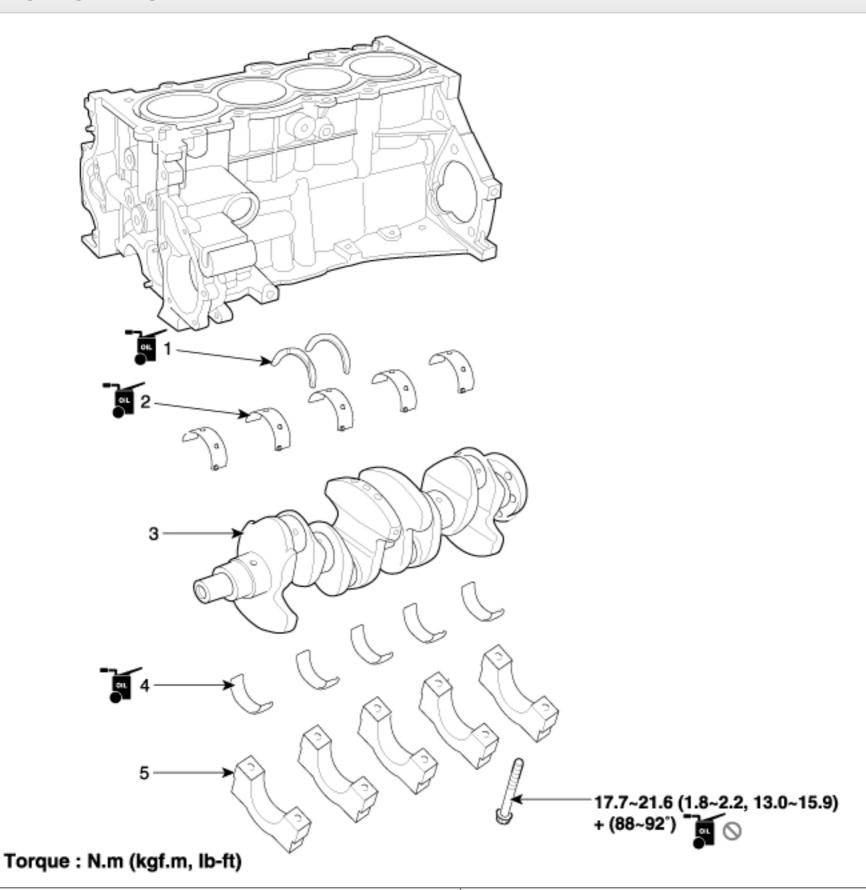
# Tightening torque:

 $7.8 \sim 11.7 \text{ N.m} (0.8 \sim 1.2 \text{ kgf.m}, 5.7 \sim 8.6 \text{ lb-ft})$ 



3. Install in the reverse order of removal.

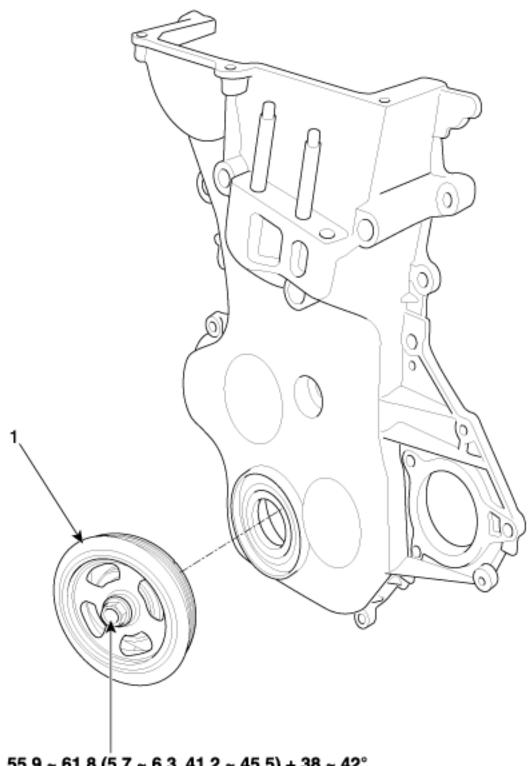
# **COMPONENTS**



- 1. Thrust bearing
- 2. Main bearing (Upper)
- 3. Crankshaft

- 4. Main bearing (Lower)
- 5. Main bearing cap

# **COMPONENTS**



55.9 ~ 61.8 (5.7 ~ 6.3, 41.2 ~ 45.5) + 38 ~ 42°

Torque: N.m (kgf.m, lb-ft)

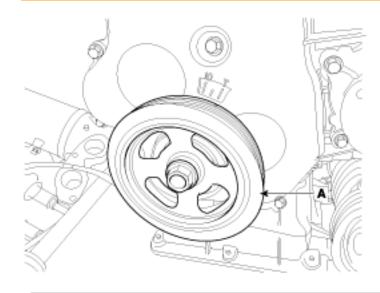
1. Crankshaft damper pulley

### **REMOVAL AND INSTALLATION**

- 1. Remove the passenger seat RH front tire.
- 2. Remove the engine room under cover.
- 3. Remove the crankshaft bolt (B) and crankshaft pulley (A).

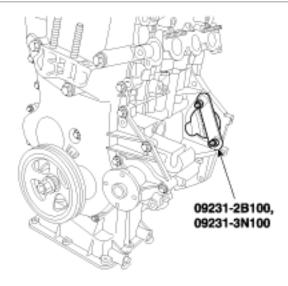
#### **Tightening torque:**

 $55.9 \sim 61.8 \text{ N.m} (5.7 \sim 6.3 \text{ kgf.m}, 41.2 \sim 45.5 \text{ lb-ft}) + 38 \sim 42^{\circ}$ 



# NOTICE

Use the SST (flywheel stopper, 09231-2B100, 09231-3N100) to remove the crankshaft pulley bolt, after remove the starter.



4. Install in the reverse order of removal.

#### **DISASSEMBLY**

#### NOTICE

- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

### i Information

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No.1 piston is at TDC (Top dead center).
- Remove the engine assembly from the vehicle.
   (Refer to Engine and Transaxle Assembly "Engine and Transaxle Assembly")
- 2. Remove the transaxle assembly from the engine assembly.

Manual Transaxle.

(Refer to Manual Transaxle System - "Manual Transaxle")

Automatic Transaxle.

(Refer to Automatic Transaxle System - "Automatic Transaxle")

- 3. Manual Transaxle: Remove the flywheel.
  - (Refer to Cylinder Block "Flywheel")

Automatic Transaxle: Remove the drive plate.

(Refer to Cylinder Block - "Drive Plate")

- 4. Install the engine to engine stand for disassembly.
- 5. Remove the timing chain.

(Refer to Timing System - "Timing Chain")

6. Remove the intake manifold.

(Refer to Intake and Exhaust System - "Intake Manifold")

7. Remove the exhaust manifold.

(Refer to Intake and Exhaust System - "Exhaust Manifold")

8. Remove the cylinder head assembly.

(Refer to Cylinder Head Assembly - "Cylinder Head")

9. Remove the water pipe.

(Refer to Cooling System - "Water Pipe")

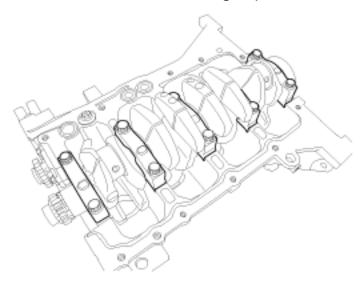
10. Remove the water temperature control assembly.

(Refer to Cooling System - "Water Temperature Control Assembly")

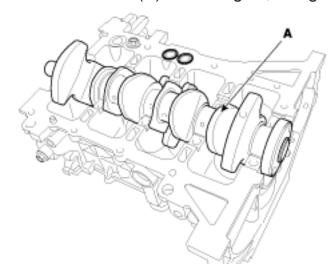
11. Remove the oil pan and oil screen.

(Refer to Lubrication System - "Oil Pan")

- Remove the ladder frame.
   (Refer to Cylinder Block "Cylinder Block")
- Remove the piston and connecting rod assemblies.
   (Refer to Cylinder Block "Piston and Connecting Rod")
- 14. 14. Remove the main bearing caps and check oil clearance.



- 15. Check the crankshaft end play.
- 16. Lift the crankshaft (A) out of engine, being careful not to damage journals.



### NOTICE

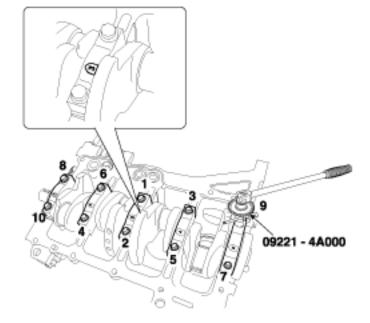
Arrange the main bearings and center bearings in the correct order.

#### INSPECTION

- 1. Check the connecting rod bearing oil clearance.
  - (1) To check main bearing-to-journal oil clearance, remove the main bearings.
  - (2) Clean each main journal and bearing half with a clean shop tower.
  - (3) Place one strip of plastigage across each main journal.
  - (4) Use the SST (09221-4A000), reinstall the bearings and bolts as following method with specified torque. In the sequence.

#### **Tightening torque:**

 $17.7 \sim 21.6 \text{ N.m} (1.8 \sim 2.2 \text{ kgf.m}, 13.0 \sim 15.9 \text{ lb-ft}) + 88 \sim 92^{\circ}$ 



(5) Remove the cap and bearing again, and measure the widest part of the plastigage.

#### Standard oil clearance:

 $0.006 \sim 0.024 \text{ mm} (0.0002 \sim 0.0009 \text{ in})$ 

(6) If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

# **▲** CAUTION

Do not file, shim, or scrape the bearings or the caps to adjust clearance.

(7) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

#### NOTICE

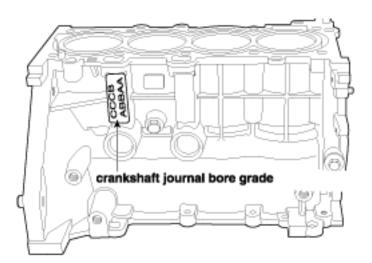
If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

# **▲** CAUTION

If the marks are indecipherable because of an accumulation of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.

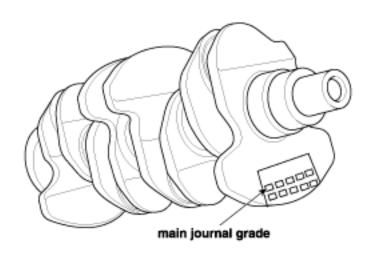
#### Cylinder block crankshaft journal bore mark location

Letters have been stamped on the block as a mark for the size of each of the 5 main journal bores. Use them, and the numbers or bar stamped on the crank (marks for main journal size), to choose the correct bearings.



а	А	42.000 ~ 42.006 mm (1.6535 ~ 1.6537 in)
b	В	42.006 ~ 42.012 mm (1.6537 ~ 1.6540 in)
С	С	42.012 ~ 42.018 mm (1.6540 ~ 1.6542 in)

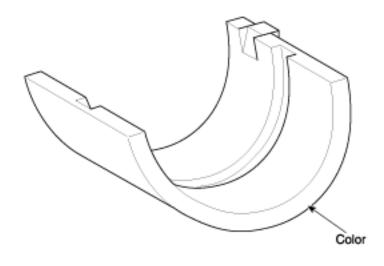
# **Crankshaft Main Journal Mark Location**



# **Discrimination of Crankshaft Main Journal**

Class	Mark	Crankshaft main journalouter diameter
I	1	42.954 ~ 42.960 mm (1.6911 ~ 1.6913 in)
II	2	42.948 ~ 42.954 mm (1.6908 ~ 1.6911 in)
III	3	42.942 ~ 42.948 mm (1.6906 ~ 1.6908 in)

# **Crankshaft Main Bearing Mark Location**



Mark	Color	Connecting Rod Bearing Thickness	
А	Blue	2.026 ~ 2.029 mm (0.0797 ~ 0.0798 in)	
В	Black	2.023 ~ 2.026 mm (0.0796 ~ 0.0797 in)	
С	None	2.020 ~ 2.023 mm (0.0795 ~ 0.0796 in)	
D	Green	2.017 ~ 2.020 mm (0.0794 ~ 0.0795 in)	

(8) Select the bearing by using selection table.

#### **Crankshaft Main Bearing Selection Table**

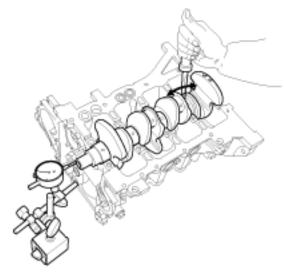
Crankshaft Main Bearing		Cylinder Block Crankshaft Journal Bore Mark		
		a (A)	b (B)	c (C)
	I (1)	E (Yellow)	D (Green)	C (None)
Crank shaft main journal mark	II (2)	D (Green)	C (None)	B (Black)
journarman	III (3)	C (None)	B (Black)	A (Blue)

2. Check crankshaft end play.

Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

### Standard end play:

 $0.05 \sim 0.25 \text{ mm} (0.0019 \sim 0.0098 \text{ in})$ 



If the end play is greater than maximum, replace the center bearings as a set.

#### Thrust bearing thickness:

 $1.925 \sim 1.975 \text{ mm} (0.0757 \sim 0.0777 \text{ in})$ 

#### Crankshaft end play:

 $0.05 \sim 0.25 \text{ mm} (0.0019 \sim 0.0098 \text{ in})$ 

3. Inspect the crankshaft main journals and pin journals.

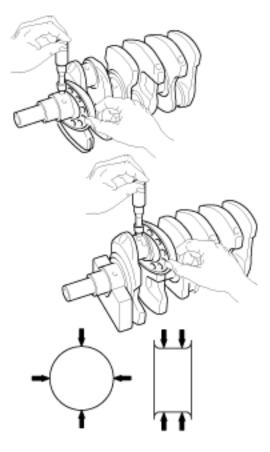
Using a micrometer, measure the diameter of each main journal and pin journal.

#### Main journal diameter:

42.942 ~ 42.960 mm (1.6906 ~ 1.6913 in)

#### Pin journal diameter:

38.954 ~ 38.972 mm (1.53<u>36 ~ 1.5343 in)</u>



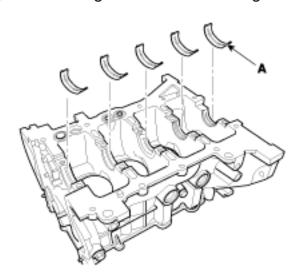
# **REASSEMBLY**

1. Install the crankshaft main bearings.

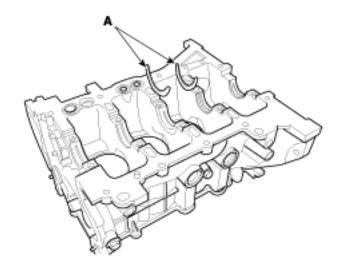
# NOTICE

Upper bearings have an oil groove of oil holes; Lower bearings do not.

(1) Align the bearing claw with the claw groove of the cylinder block, push in the 5 upper bearings (A).

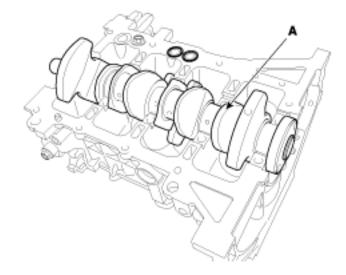


(2) Install the thrust bearings.
Install the 2 thrust bearings (A) under the No.3 journal position of the cylinder block with the oil grooves facing outward.



- (3) Install the crankshaft lower main bearing.

  Align the bearing claw with the groove of the crankshaft lower bearing and crankshaft main bearing cap.
- 2. Place the crankshaft (A) on the cylinder block.



3. Install the main bearing cap (A).

### NOTICE

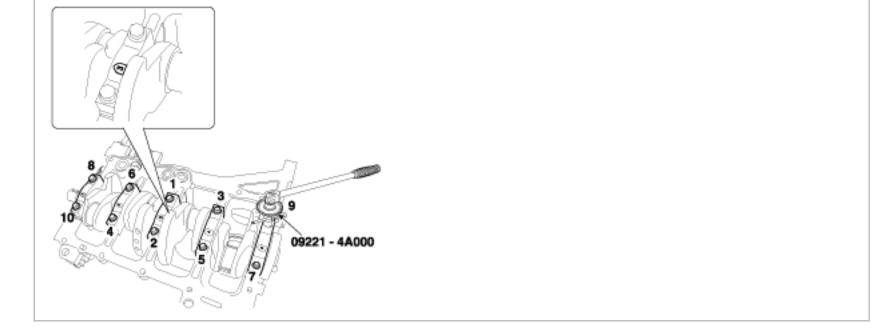
- Always use new main bearing cap bolts.
- • If any of the bearing cap bolts are broken or deformed, replace it.
- (1) Apply a light coat of engine oil on the threads and under the bearing cap bolts.
- (2) Install and uniformly tighten the 10 bearing cap bolts, in several passes, in the sequence shown.

#### Tightening torque:

 $17.7 \sim 21.6 \text{ N.m} (1.8 \sim 2.2 \text{ kgf.m}, 13.0 \sim 15.9 \text{ lb-ft}) + 88 \sim 92^{\circ}$ 

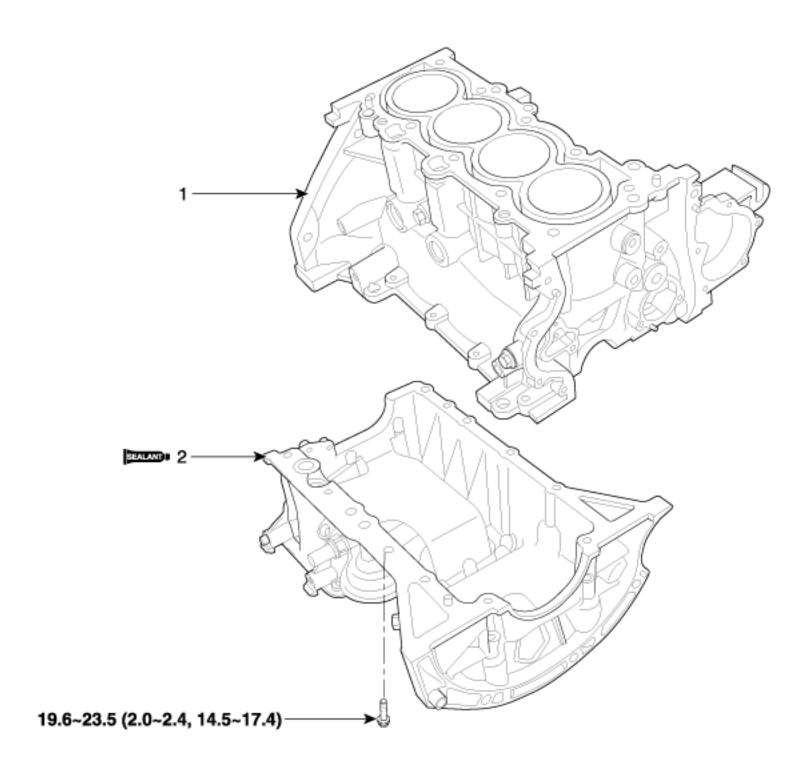
### NOTICE

Using the SST (09221-4A000), tighten the bolts which need to be tightened with the angular tightening method.



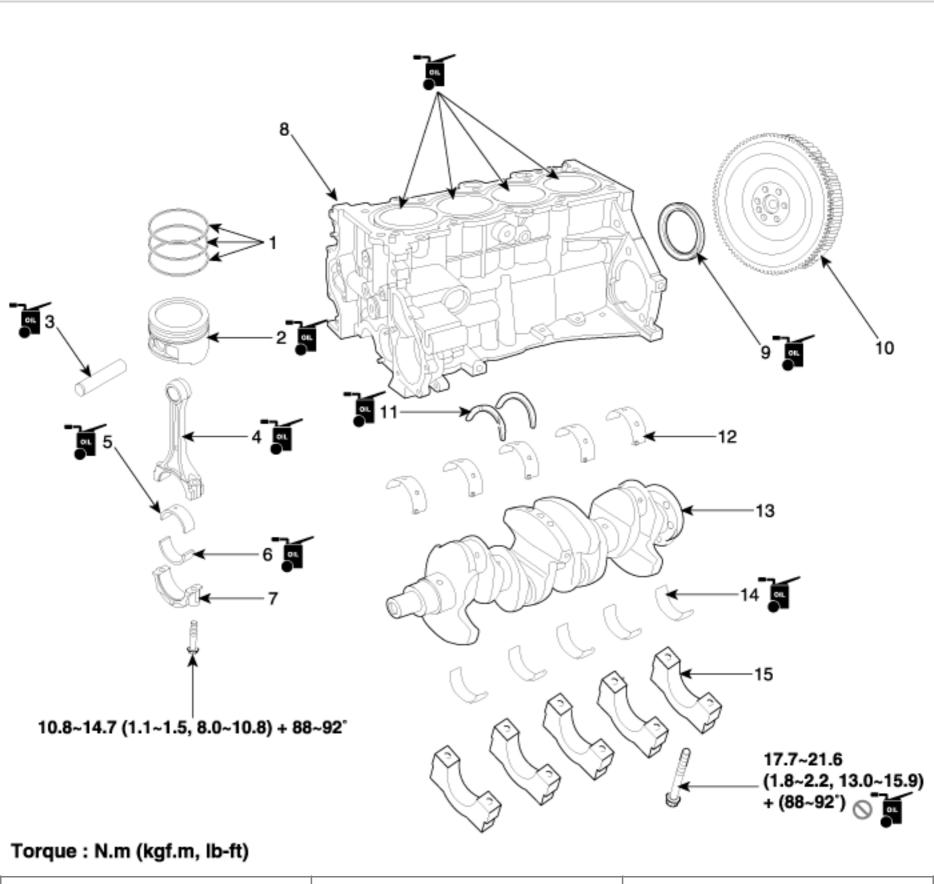
- (3) Check that the crankshaft turns smoothly.
- 4. Check the crankshaft end play.
- 5. Assemble the other parts in the reverse order of disassembly.

# **COMPONENTS**



Torque: N.m (kgf.m, lb-ft)

1. Cylinder block	2. Ladder frame
-------------------	-----------------



- 1. Piston ring
- 2. Piston
- 3. Piston pin
- 4. Connecting rod
- 5. Connecting rod upper bearing
- 6. Connecting rod lower bearing
- 7. Connecting rod cap
- 8. Cylinder block
- 9. Rear oil seal
- 10. Flywheel

- 11. Thrust bearing
- 12. Main bearing (Upper)
- 13. Crankshaft
- 14. Main bearing (Lower)
- 15. Main bearing cap

#### **DISASSEMBLY**

#### NOTICE

- · Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

### information

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No.1 piston is at TDC (Top dead center).
- Remove the engine assembly from the vehicle.
   (Refer to Engine and Transaxle Assembly "Engine and Transaxle Assembly")
- 2. Remove the transaxle assembly from the engine assembly.

Manual Transaxle.

(Refer to Manual Transaxle System - "Manual Transaxle")

Automatic Transaxle.

(Refer to Automatic Transaxle System - "Automatic Transaxle")

- 3. Manual Transaxle: Remove the flywheel.
  - (Refer to Cylinder Block "Flywheel")

Automatic Transaxle: Remove the drive plate.

(Refer to Cylinder Block - "Drive Plate")

- 4. Install the engine to engine stand for disassembly.
- 5. Remove the timing chain.

(Refer to Timing System - "Timing Chain")

6. Remove the intake manifold.

(Refer to Intake and Exhaust System - "Intake Manifold")

7. Remove the exhaust manifold.

(Refer to Intake and Exhaust System - "Exhaust Manifold")

8. Remove the cylinder head assembly.

(Refer to Cylinder Head Assembly - "Cylinder Head")

9. Remove the water pipe.

(Refer to Cooling System - "Water Pipe")

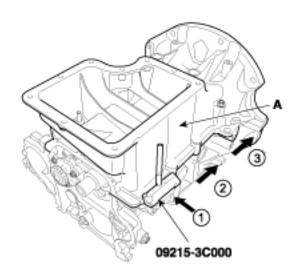
10. Remove the water temperature control assembly.

(Refer to Cooling System - "Water Temperature Control Assembly")

11. Remove the oil pan and oil screen.

(Refer to Lubrication System - "Oil Pan")

12. Remove the ladder frame (A).
Insert the blade of SST (09215-3C000) between the cylinder block and the ladder frame. Cut off applied sealer and remove the ladder frame.



- Remove the piston and connecting rod assemblies.
   (Refer to Cylinder Block "Piston and Connecting Rod")
- 14. Remove the crankshaft.

  (Refer to Cylinder Block "Crankshaft")

### **INSPECTION**

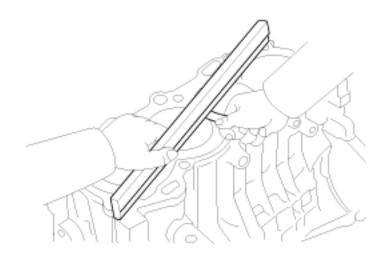
# Cylinder Block

- Remove the gasket material.
   Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.
- Clean the cylinder block.
   Using a soft brush and solvent, thoroughly clean the cylinder block.
- Inspect the top surface of the cylinder block for flatness.
   Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

### Flatness of cylinder block gasket surface

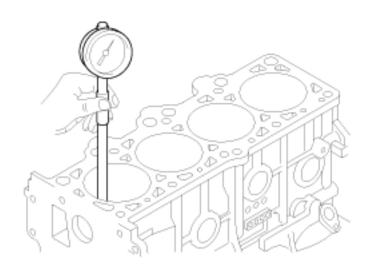
Standard: Less than 0.05 mm (0.002 in),

Less than 0.02 mm (0.0008 in) / 100 x 100 (3.937 x 3.937 in)

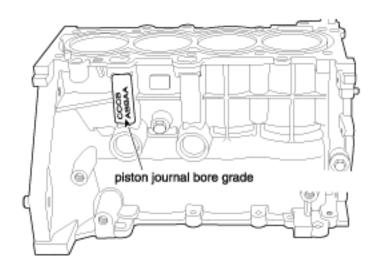


Inspect the cylinder bore.
 Visually check the cylinder for vertical scratchs.
 If deep scratchs are present, replace the cylinder block.

5. Inspect the cylinder bore diameter.
Using a cylinder bore gauge, measure the cylinder bore diameter at position in the thrust and axial direction.



6. Check the cylinder bore size code on the cylinder block.

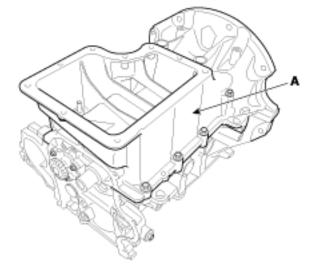


# Discrimination of cylinder bore size

Grade	Size code	Cylinder Bore inner Diameter		
а	А	71.00 ~ 71.01mm (2.7952 ~ 2.7956 in)		
b	В	71.01 ~ 71.02 mm (2.7956 ~ 2.7960 in)		
c C		71.02 ~ 71.03 mm (2.7960 ~ 2.7964 in)		

## **REASSEMBLY**

- Remove the crankshaft.
   (Refer to Cylinder Block "Crankshaft")
- Remove the piston and connecting rod assemblies. (Refer to Cylinder Block - "Piston and Connecting Rod")
- 3. Install the ladder frame (A).

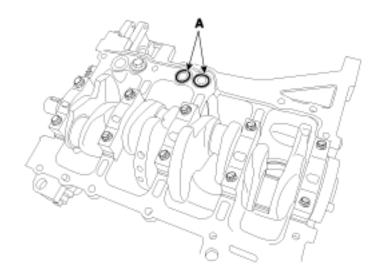


(1) Using a gasket scraper, remove all the old packing material.

## NOTICE

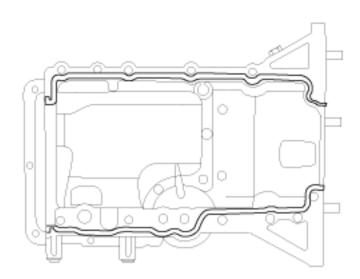
Be careful not to damage the contact surfaces.

(2) Install the O-ring (A) to cylinder block.



(3) Before assembling the ladder frame, the liquid sealant TB1217H should be applied on ladder frame. The part must be assembled within 5minutes after the sealant was applied.

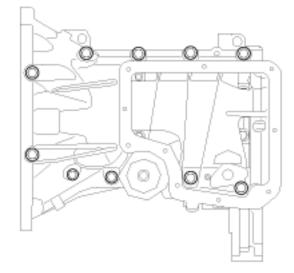
**Bead width:** 2.5 ~ 3.5 mm (0.1 ~ 0.14 in)



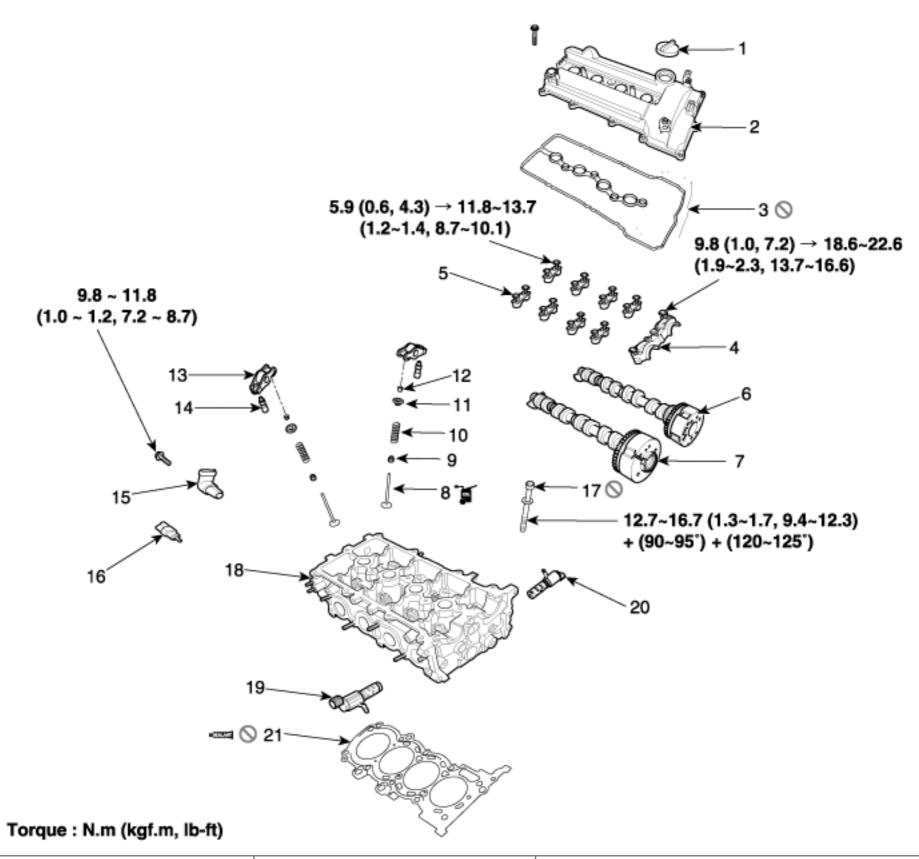
(4) Install and uniformly tighten the ladder frame bolts, in several passes.

### **Tightening torque:**

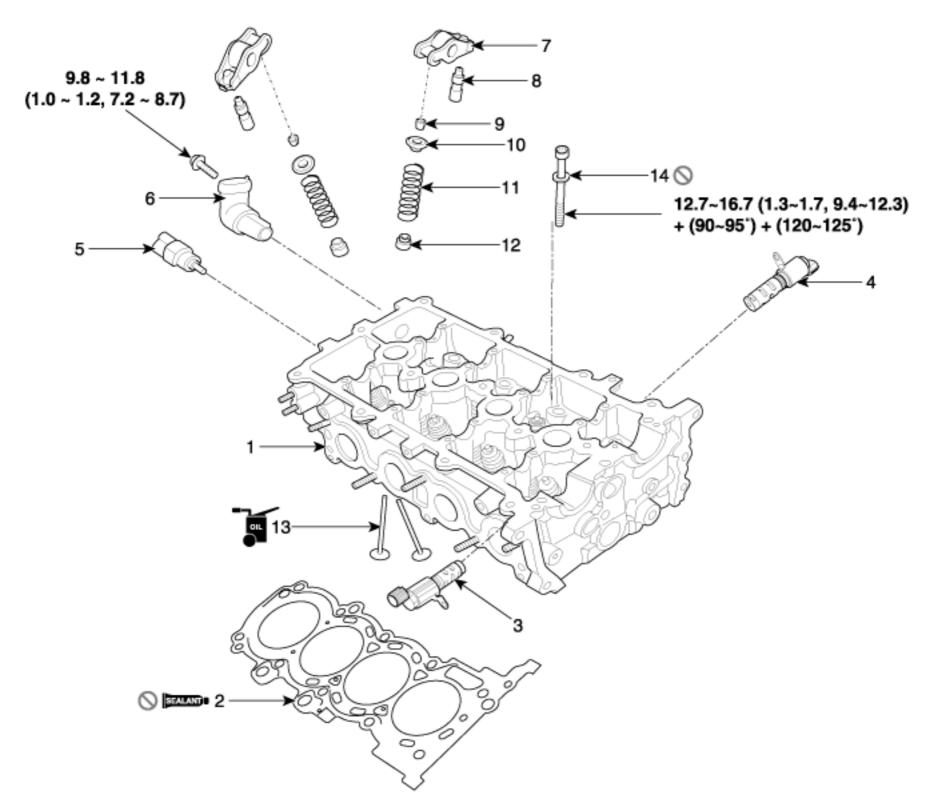
19.6 ~ 23.5 N.m (2.0 ~ 2.4 kgf.m, 14.5 ~ 17.4 lb-ft)



4. Assemble the other parts in the reverse order of disassembly.



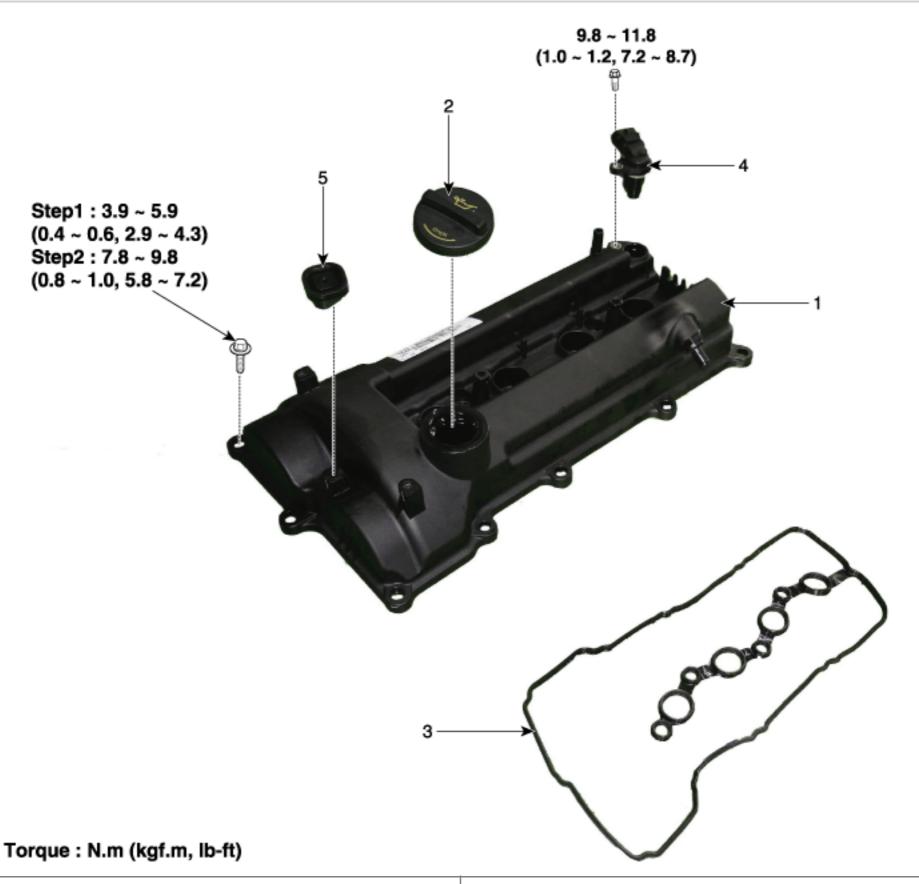
- 1. Oil filler cap
- 2. Cylinder head cover
- 3. Cylinder head cover gasket
- 4. Camshaft bearing cap
- 5. Front camshaft bearing cap
- 6. Intake CVVTassembly
- 7. Exhaust CVVT assembly
- 8. Valve
- 9. Valve stem seal
- 10. Valve spring
- 11. Retainer
- 12. Retainer lock
- 13. Swing arm
- 14. HLA (Hydraulic Lash Adjuster)
- 15. CMP (Camshaft Position) sensor
- 16. ECT (Engine Coolant Temperature) sensor
- 17. Cylinder head bolt
- 18. Cylinder head assembly
- 19. Exhaust OCV (Oil control valve)
- 20. Intake OCV (Oil control valve)
- 21. Cylinder head gasket



Torque: N.m (kgf.m, lb-ft)

- 1. Cylinder head assembly
- 2. Cylinder head gasket
- 3. Intake OCV (Oil control valve)
- 4. Exhaust OCV (Oil control valve)
- 5. ECT (Engine Coolant Temperature) sensor
- 6. CMP (Camshaft Position) sensor
- 7. Swing arm

- 8. HLA (Hydraulic Lash Adjuster)
- 9. Retainer lock
- 10. Retainer
- 11. Valve spring
- 12. Valve stem seal
- 13. Valve
- 14. Cylinder head bolt



- 1. Cylinder head cover
- 2. Engine oil cap

- 3. Cylider head cover gasket
- 4. Camshaft position sensor

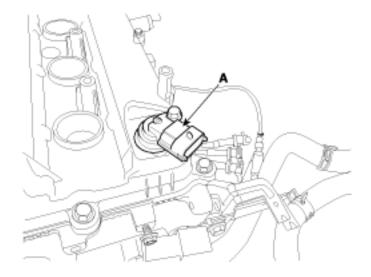
### **REMOVAL**

## **▲** CAUTION

- Use fender covers to avoid damaging painted surfaces.
- • To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

### NOTICE

- Mark all wiring and hoses to avoid misconnection.
- • Turn the crankshaft pulley so that the No.1 piston is at top dead center.
- 1. Disconnect the battery negative terminal.
- Remove the air cleaner assembly. (Refer to Intake and Exhaust System - "Air Cleaner")
- Remove the ignition coils.
   (Refer to Engine Electrical System "Ignition Coil")
- 4. Remove the exhaust CMPS (Camshaft Position Sensor) (A).



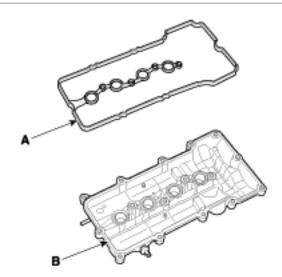
5. Remove the cylinder head cover (A).



- 1. 1. Install the cylinder head cover.
  - (1) Install new cylinder head cover gasket (A) on the cylinder head cover (B).

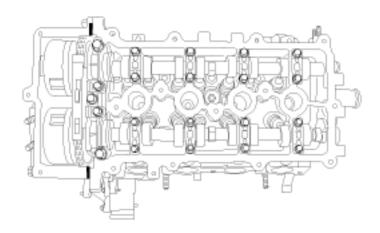


Do not reuse the cylinder head cover gasket.



- (2) The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
- (3) After applying sealant (MS721-40AA), it should be assembled within 5 minutes.

**Bead width:** 2.0 ~ 3.0 mm (0.08 ~ 0.12 in.)



(4) Install the cylinder head cover bolts as following method with two steps.

#### **Tightening torque**

Step 1: 3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft) Step 2: 7.8 ~ 9.8 N.m (0.8 ~ 1.0 kgf.m, 5.8 ~ 7.2 lb-ft)



2. Install the other parts in the reverse order of removal.

### **REMOVAL**

Engine removal is not required for this procedure.

### **▲** CAUTION

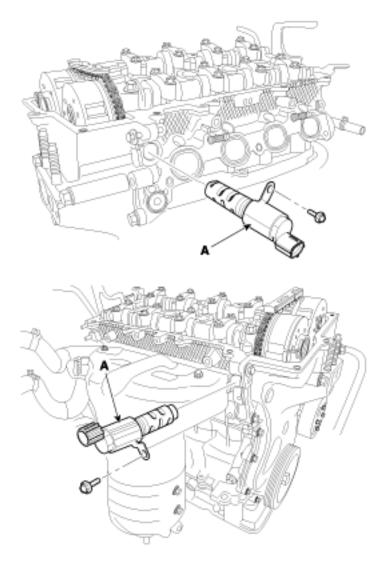
- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature (20°C [68°F]) before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

### NOTICE

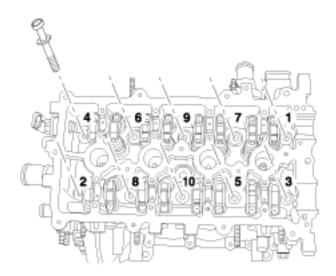
- · Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.
- Remove the Battery.
   (Refer to Engine Electrical System "Battery")
- Remove the air cleaner assembly.
   (Refer to Intake and Exhaust System "Air Cleaner")
- Remove the battery tray.
   (Refer to Engine Electrical System "Battery")
- Remove the engine room under cover and side covers.
   (Refer to Engine and Transaxle Assembly "Engine Room Under Cover")
- Drain the coolant. (Refer to Cooling System - "Coolant")
- Remove the cylinder head cover.
   (Refer to Cylinder Head Assembly "Cylinder Head Cover")
- Remove the timing chain.(Refer to Timing System "Timing Chain")
- 8. Remove the exhaust manifold. (Refer to Intake and Exhaust System "Exhaust Manifold")
- Remove the intake manifold.
   (Refer to Intake and Exhaust System "Intake Manifold")
- Remove the camshaft.
   (Refer to Cylinder Head Assembly "CVVT & Camshaft")
- Remove the ignition coil.
   (Refer to Engine Electrical System "Ignition Coil")
- 12. Remove the Intake CMPS (Camshaft Position Sensor) (A), air cleaner mounting bracket (B).



13. Remove the intake / exhaust OCV (Oil control valve) (A).



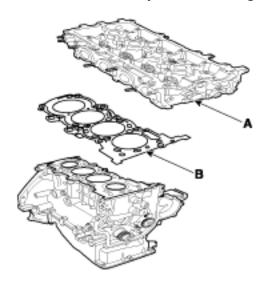
14. Uniformly loosen and remove the cylinder head bolts, in several passes, in the sequence shown.



## NOTICE

Head warpage or cracking could result from removing bolts in an incorrect order.

15. Lift the cylinder head (A) from the dowels on the cylinder block and place the cylinder head on wooden blocks on a bench. and remove the cylinder head gasket (B).

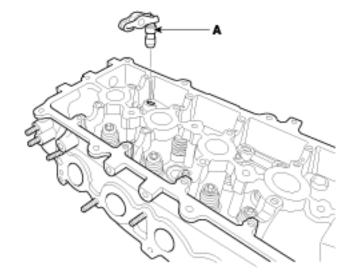


## NOTICE

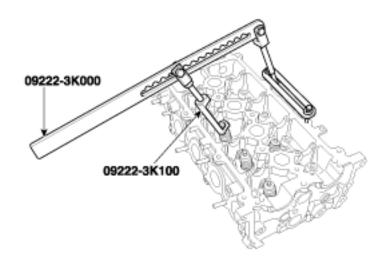
Be careful not to damage the contact surfaces of the cylinder head and cylinder block.

### **DISASSEMBLY**

1. Remove the swing arm and the hydraulic lash adjuster assembly (A).

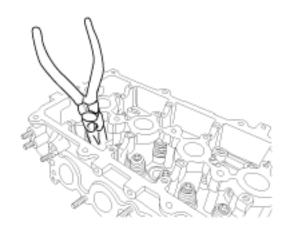


- 2. Remove the valves.
  - (1) Using the SST (09222-3K000, 09222-3K100), press the valve spring and remove retainer lock.



- (2) Remove the spring retainer.
- (3) Remove the valve spring.
- (4) Remove the valve.

(5) Using the pliers, remove the valve stem seal.



### NOTICE

Do not reuse old valve stem seals.

#### **INSPECTION**

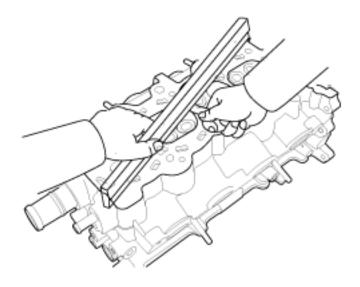
## Cylinder Head

1. Inspect for flatness.

Using a precision straight edge and feeler gauge, measure the surface contacting cylinder block and the manifolds for warpage.

### Flatness of cylinder head gasket surface

Standard: Less than 0.05 mm (0.0020 in) Less than 0.02 mm (0.0008 in) / 100 x 100 **Flatness of manifold gasket surface** Standard: Less than 0.1 mm (0.0039 in)



2. Inspect for cracks.

Check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.

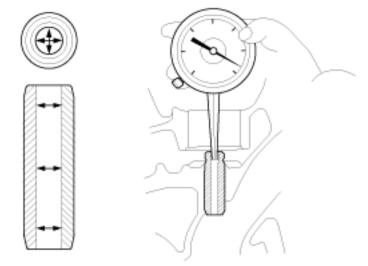
# Valve and Valve Spring

- 1. Inspect valve stems and valve guides.
  - (1) Using a caliper gauge, measure the inside diameter of the valve guide.

#### Valve guide I.D.

Intake / Exhaust :

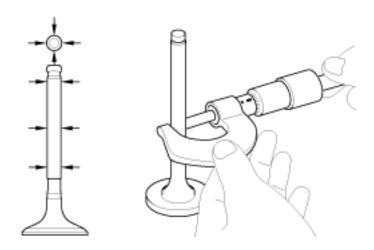
5.500 ~ 5.512 mm (0.2165 ~0.2170 in)



(2) Using a micrometer, measure the diameter of the valve stem.

#### Valve stem O.D.

Intake :  $5.465 \sim 5.480 \text{ mm} (0.2151 \sim 0.2157 \text{ in})$ Exhaust :  $5.448 \sim 5.460 \text{ mm} (0.2144 \sim 0.2149 \text{ in})$ 



(3) Subtract the valve stem diameter measurement from the valve guide inside diameter measurement.

#### Valve stem-to-guide clearance

Intake :  $0.020 \sim 0.047 \text{ mm} (0.00078 \sim 0.00185 \text{ in})$ Exhaust :  $0.040 \sim 0.064 \text{ mm} (0.00157 \sim 0.00251 \text{ in})$ 

### 2. Inspect valves.

(1) Check the valve is ground to the correct valve face angle.

### Valve face angle

Intake/Exhaust: 45.25° ~ 45.75°

- (2) Check that the surface of the valve for wear. If the valve face is worn, replace the valve.
- (3) Check the valve head margin thickness. If the margin thickness is less than minimum, replace the valve.

#### Margin

Intake: 1.5 mm (0.0590 in) Exhaust: 1.75 mm (0.0688 in)



(4) Check the valve length.

Length

Intake: 100.94 mm (3.9740 in) Exhaust: 101.09 mm (3.9799 in)

(5) Check the surface of the valve stem tip for wear. If the valve stem tip is worn, replace the valve.

- 3. Inspect valve seats.
  - (1) Check the valve seat for evidence of overheating and improper contact with the valve face. If the valve seat is worn, replace cylinder head.
  - (2) Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace cylinder head.
  - (3) Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.

#### Valve seat contact width:

Intake:  $0.85 \sim 1.15 \text{ mm} (0.0334 \sim 0.0452 \text{ in})$ Exhaust:  $1.35 \sim 1.65 \text{ mm} (0.0531 \sim 0.0649 \text{ in})$ 

Valve seat angle:

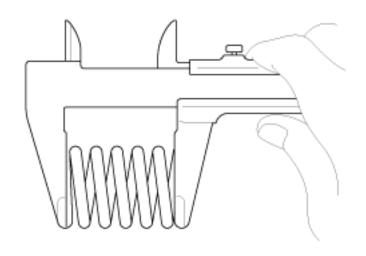
Intake / Exhaust : 44.75° ~ 45.10°

- 4. Inspect valve springs.
  - (1) Using a steel square, measure the out-of-square of the valve spring.
  - (2) Using vernier calipers, measure the free length of the valve spring.

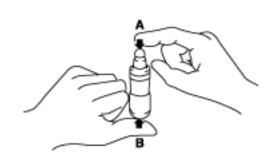
#### Valve spring

Free height: 47.9 mm (1.8858 in)

Out-of-square: 1.5° (MAX)



With the HLA filled with engine oil, hold A and press B by hand. If B moves, replace the HLA.



Problem	Possible cause	Action	
Temporary noise when starting a cold engine	Normal	This noise will disappear after the oil in the engine reaches the normal pressure.	
2. Continuous noise when the engine is started after parking more than 48 hours.	Oil leakage of the high pressure chamber on the HLA, allowing air to get in.	Noise will disappear within 15 minutes when engine runs at 2000-3000 rpm.lf it doesn't disappear, refer to step 7 below.	
3. Continuous noise when the engine is first started after rebuilding cylinder head.	Insufficient oil in cylinder head oil gallery.		
4. Continuous noise when the engine is started after excessively cranking the engine by the starter motor or band.	Oil leakage of the high-pressure chamber in the HLA, allowing air to get in.Insufficient oil in the		
5. Continuous noise when the engine is running after changing the HLA.	HLA.	Do not run engine at a speed higher than 3000 rpm, as this may damage the HLA.	
	Engine oil level too high or too low.	Check oil level.Drain or add oil as necessary.	
6. Continuous noise during idle after high engine speed.	Excessive amount of air in the oil at high engine speed.	Check oil supply system.	
	Deteriorated oil.	Check oil quality.If deteriorated, replace with specified type.	
	Low oil pressure.	Check oil pressure and oil supply system of each part of engine.	
7. Noise continues for more than 15 minutes.	Faulty HLA.	Remove the cylinder head cover and press HLA down by hand. If it moves, replace the HLA.  Be careful with the hot HLAS.	

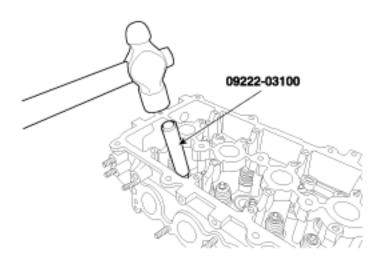
## **REASSEMBLY**

## NOTICE

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- 1. Install the valves.
  - (1) Using the SST (09222-03100), push in a new valve stem seal.



- · Do not reuse old valve stem seals.
- Incorrect installation of the seal could result in oil leakage past the valve guides.

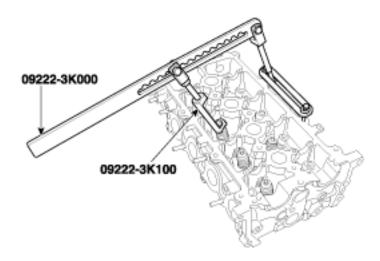


(2) Install the valve, valve spring and spring retainer.

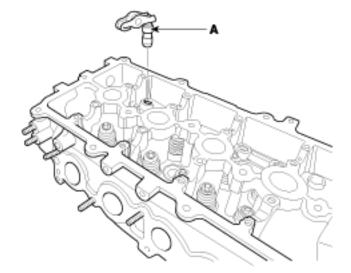
### NOTICE

Place valve springs so that the cone shape side is upward retainer side.

(3) Using the SST (09222-3K000, 09222-3K100), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.



- (4) Lightly tap the end of each valve stem two or three times with the wooden handle of a hammer to ensure proper seating of the valve and retainer lock.
- 2. Install the swing arm and the hydraulic lash adjuster assembly (A).



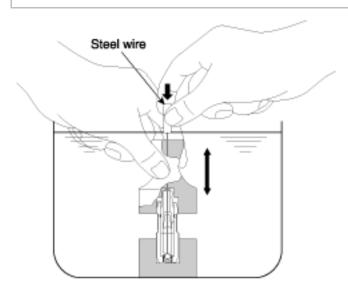
(1) Until installing HLA shall be held upright so that engine oil in HLA should not spill and assured that dust does not adhere to HLA.

(2) HLA shall be inserted tenderly to the cylinder head not to spill engine oil from HLA. In case of spilling, air vent shall be done in accordance with the air bent procedure.

### NOTICE

Stroke HLA in engine oil 4~5 times by pushing its cap while pushing the ball down slightly by hard steel wire.

(Take care not to severely push hard steel wire down since ball is several grams.)



## NOTICE

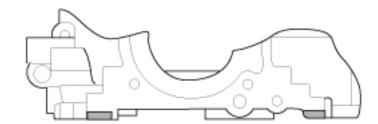
After installed on engine, lash adjuster might give out unusual noise. If air is mingled then apply slow racing (Approx. one minute for 1 racing) from idle to 3000rpm and is removed from adjuster.

#### INSTALLATION

### NOTICE

- Thoroughly clean all parts to be assembled.
- Always use a new head and manifold gasket.
- The cylinder head gasket is a metal gasket. Take care not to bend it.
- Rotate the crankshaft, set the No.1 piston at TDC.
- 1. Install the cylinder head gasket.
  - (1) The sealant locations on cylinder head gasket, cylinder block and timing chain lower case must be free of engine oil and etc.
  - (2) Apply sealant TB1217 or LT5900 on the cylinder block top surface (Refer to below illustration) before assembling the cylinder head gasket.

**Bead width:** 2.0 ~ 3.0 mm (0.0787 ~ 0.1181 in)



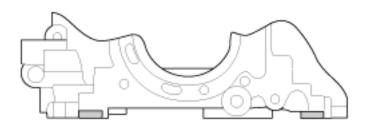
(3) Install the cylinder head gasket on the cylinder block.

### NOTICE

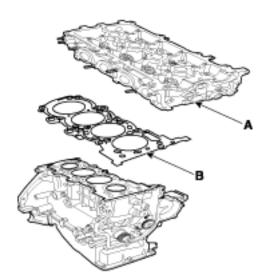
Be careful of the installation direction.

(4) Apply sealant TB1217 or LT5900 on the cylinder head gasket top surface (Refer to below illustration) after assembling the cylinder head gasket.

**Bead width:** 2.0 ~ 3.0 mm (0.0787 ~ 0.1181 in)



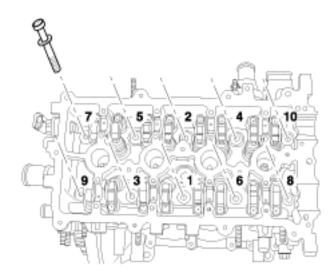
- (5) Remove the extruded sealant after assembling the cylinder head assembly.
- 2. Install the cylinder head assembly.
  - (1) Place the cylinder head assembly (A) quietly in order not to damage the gasket (B) with the bottom part of the end.



(2) Using SST (09221-4A000), tighten the cylinder head bolts and plate washers, in several passes, in the sequence shown.

#### **Tightening torque:**

 $12.7 \sim 16.7 \text{ N.m} (1.3 \sim 1.7 \text{ kgf.m}, 9.4 \sim 12.3 \text{ lb-ft}) + 90 \sim 95^{\circ} + 120 \sim 125^{\circ}$ 



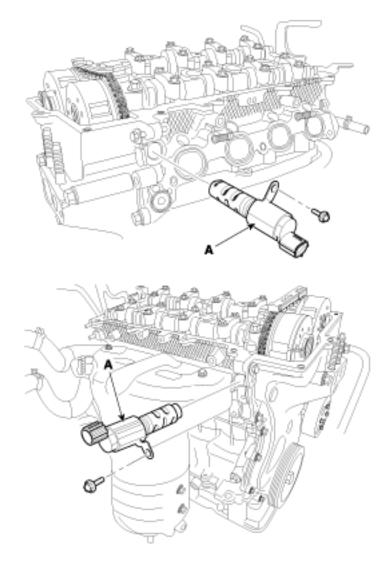
## NOTICE

Do not reuse the cylinder head bolts.

3. Install the intake / exhaust OCV (Oil control valve)(A).

### Tightening torque:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



4. Install the Intake CMPS (Camshaft Position Sensor) (A), air cleaner mounting bracket (B).

### **Tightening torque:**

 $9.8 \sim 11.8 \text{ N.m} (1.0 \sim 1.2 \text{ kgf.m}, 7.2 \sim 8.7 \text{ lb-ft})$ 



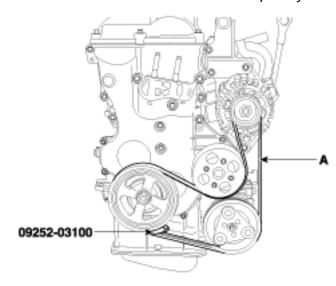
5. Install the other parts in the reverse order of removal.

#### **REMOVAL**

- 1. Remove the passenger seat RH front tire.
- 2. Remove the drive belt (A).

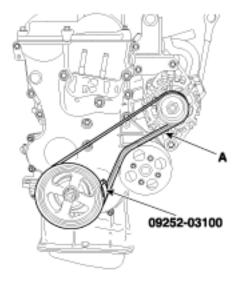
### [Full-option type]

- (1) Insert the SST (09252-03100) between the crankshaft pulley and the drive belt.
- (2) Rotate 2 revolutions of crankshaft pulley into clockwise direction. and then remove the drive belt.



### [Non-A/C type]

- (3) Insert the SST (09252-03100) between the crankshaft pulley and the drive belt.
- (4) Rotate 2 revolutions of crankshaft pulley into clockwise direction. and then remove the drive belt.

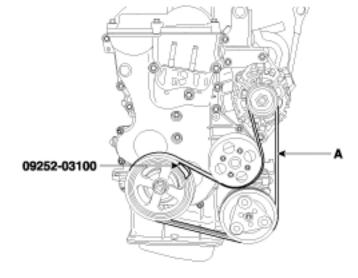


### INSTALLATION

1. Install the drive belt (A).

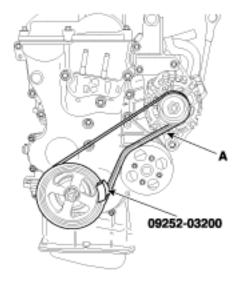
#### [Full-option type]

- (1) Pre-position the drive belt on the water pump, alternator, A/C compressor pulleys. Make sure the belt is properly fitted on groove pulleys of alternator and A/C compressor.
- (2) Insert the SST (09252-03100) between the crankshaft pulley and the drive belt.
- (3) Rotate 2 revolutions of crankshaft pulley into counterclockwise direction.
- (4) Remove the tool and make sure the belt is properly installed.



### [Non-A/C type]

- (5) Pre-position the drive belt on the water pump, alternator pulleys. Make sure the belt is properly fitted on groove pulley of alternator.
- (6) Insert the SST (09252-03200) between the crankshaft pulley and the drive belt.
- (7) Rotate 2 revolutions of crankshaft pulley into clockwise direction.
- (8) Remove the tool and make sure the belt is properly installed.



2. Install the passenger seat RH front tire.

## NOTICE

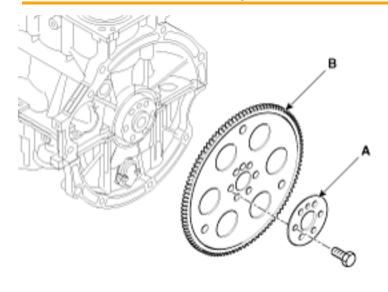
The belt must be free from any harmful damage during installation.

## **REMOVAL**

- Remove the automatic Transaxle.
   (Refer to Manual Transaxle System "Automatic Transaxle")
- 2. Remove the drive plate (A) and the adapter plate (B).

## Tightening torque:

68.6 ~ 78.5 N.m (7.0 ~ 8.0 kgf.m, 50.6 ~ 57.9 lb-ft)



## NOTICE

Do not reuse the bolts.

3. Install in the reverse order of removal.

### **REMOVAL**

## **▲** CAUTION

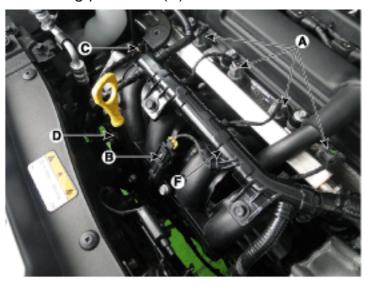
- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

### NOTICE

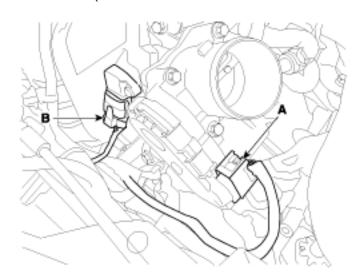
- Mark all wiring and hoses to avoid misconnection.
- For release the fuel system pressure before remove the engine assembly, start the engine without fuel pump relay, and then turn off the ignition switch after engine stops.
- 1. Disconnect the battery negative terminal.
- Remove the air duct and air cleaner assembly. (Refer to Intake and Exhaust System - "Air Cleaner")
- Disconnect the mounting bracket and then remove the battery. (Refer to Engine Electrical System - "Battery")
- Disconnect the ECM connector and then remove the ECM. (Refer to Fuel System - "Engine Control Module")
- 5. Remove the battery tray. (Refer to Engine Electrical System "Battery")
- 6. Remove the Engine room under cover.
- Loosen the drain plug and drain the coolant. Open the radiator cap to make rapid draining. (Refer to Cooling System - "Coolant")
- 8. Recover the refrigerant and remove the high & low pressure pipe. (Refer to Heating and Ventilation, Air Conditioning System "Compressor")
- Disconnect the radiator upper hose, the reservoir hose and the lower hose. (Refer to Cooling System - "Radiator Hose")
- Disconnect the AT cooler hose.
   (Refer to Automatic Transaxle System "Automatic Transaxle")
- 11. Disconnect the wiring connectors and harness clamps, and remove the wiring and protectors from the cylinder head and intake manifold.
  - (1) The exhaust OCV (Oil Control Valve) connector (A) and ground (B)



- (2) The injector connectors (A)
- (3) The knock sensor connector (B)
- (4) The intake OCV(Oil Control Valve) connector (C)
- (5) The alternator connector (D)
- (6) The air compressor switch connector (E)
- (7) The wiring protector (F)

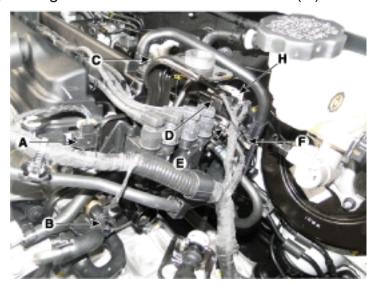


- (8) The ETC (Electronic Throttle Control) connector (A)
- (9) The MAPS (Manifold Absolute Pressure Sensor) connector (B)



- (10) The intake CMPS (Camshaft Position Sensor) connector (A)
- (11) The ECTS (Engine Coolant Temperature Sensor) connector (B)
- (12) The exhaust CMPS (Camshaft Position Sensor) connector (C)
- (13) The front oxygen sensor connector (D)

- (14) The rear oxygen sensor connector (E)
- (15) The PCSV (Purge Control Solenoid Valve) connector (F)
- (16) The ignition coil extension connector (H)



(17) The CKPS (Crankshaft Position Sensor) connector (A)



12. Disconnect the brake booster vacuum hose (A).



13. Disconnect the heater hoses (B).



14. Disconnect the fuel hose (A) and PCSV (Purge Control Solenoid Valve) (B).

### **Tightening torque:**

 $3.9 \sim 5.9 \text{ N.m} (0.4 \sim 0.6 \text{ kgf.m}, 2.9 \sim 4.3 \text{ lb-ft})$ 



15. Disconnect the (+) cables (A) from the fuse/relay box and the front connector (B).

### **Tightening torque:**

6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)



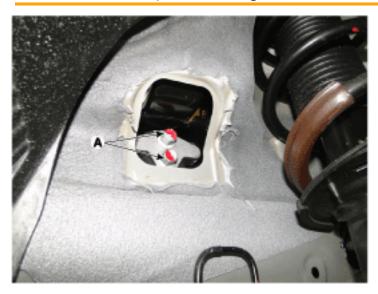
- 16. Remove the transaxle wire harness connectors and control cable from the transaxle.
- 17. Remove the steering column universal joint bolt. (Refer to Steerint System "Steering Column")
- Remove the roll rod bracket.
   (Refer to Engine and Transmission Assembly "Engine Mounting")
- Remove the front muffler.
   (Refer to Intake and Exhaust System "Muffler")
- 20. Remove the sub frame assembly.(Refer to Suspension System "Sub Frame")

### **NOTICE**

- After removing the engine and transaxle mounting bolts and nuts, the engine and transaxle assembly may be fallen downward. Support them securely with floor jack.
- Verify that the hoses and connectors are disconnected before removing the engine and transaxle assembly.
- 21. Disconnect the ground cable, and then remove the engine suppert mounting bracket. (Engine and Transaxle Assembly "Engine Mounting")
- 22. Remove the transaxle mounting bracket through bolt (A).

#### **Tightening torque:**

88.3 ~ 107.9 N.m (9.0 ~ 11.0 kgf.m, 65.1 ~ 79.6 lb-ft)



23. Remove the engine and transaxle assembly by lifting vehicle.



## **▲** CAUTION

When remove the engine and transaxle assembly, be careful not to damage any surrounding parts or body components.

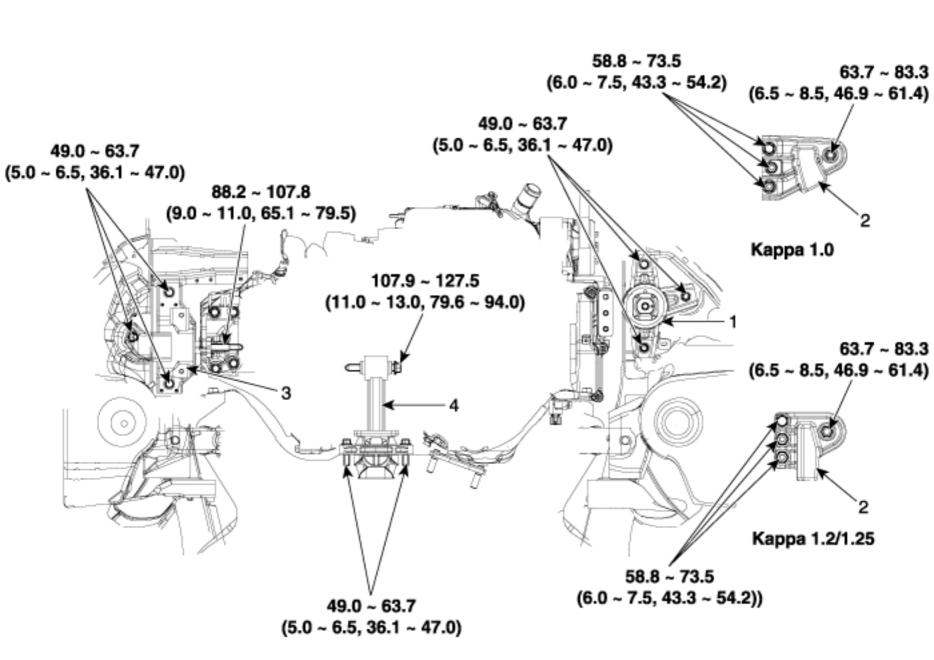
### **INSTALLATION**

Installation is in the reverse order of removal.

Perform the following:

- Adjust the shift cable.
- Refill engine with engine oil.
- Refill transaxle with fluid.

- Clean the battery posts and cable terminals with sandpaper assemble them, then apply grease to prevent corrosion.
- Inspect for fuel leakage.
- After assembling the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.
- Repeat this operation two or three times, then check for fuel leakage at any point in the fuel lines.
- Refill radiator with engine coolant.
- Bleed air from the cooling system.
- Start engine and let it run until it warms up. (Until the radiator fan operates 3 or 4 times.)
- Turn Off the engine. Check the level in the radiator, add coolant if needed. This will allow trapped air to be removed from the cooling system.
- Put radiator cap on tightly, then run the engine again and check for leaks.



## Torque : N.m (kgf.m, lb-ft)

1.	Engine	mounting	bracket
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2. Engine mounting support bracket

- 3. Transaxle mounting bracket
- 4. Roll rod bracket

#### **REMOVAL AND INSTALLATION**

## [Egnine mounting support bracket]

1. Install the jack to the edge of upper oil pan to support the engine.

### NOTICE

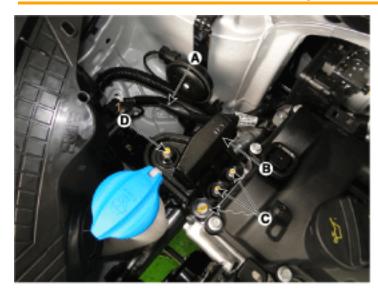
Put the rubber block between the jack and oil pan to avoid damaging the oil pan.

2. Disconnect the ground (A), and then remove the engine mounting bracket (B).

### **Tightening torque**

Bolt and Nuts (C): 58.8 ~ 73.5 N.m (6.0 ~ 7.5 kgf.m, 43.3 ~ 54.2 lb-ft)

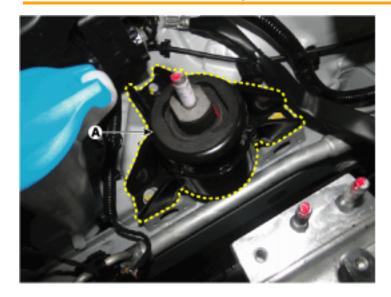
Nut (D): 63.7 ~ 83.3 N.m (6.5 ~ 8.5 kgf.m, 46.9 ~ 61.4 lb-ft)



3. Remove the engine mounting bracket (A).

### **Tightening torque**

49.0 ~ 63.7 N.m (5.0 ~ 6.5 kgf.m, 36.1 ~ 47.0 lb-ft)



4. Installation is reverse order of removal.

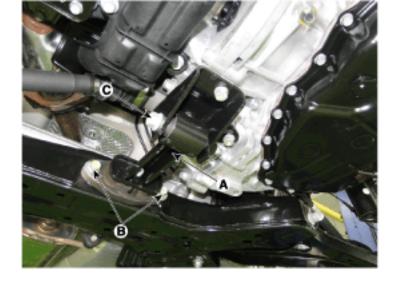
# [Roll road Mounting]

1. Remove the roll rod bracket (A).

#### **Tightening torque**

B:  $49.0 \sim 63.7 \text{ N.m}$  (5.0  $\sim 6.5 \text{ kgf.m}$ ,  $28.9 \sim 47.0 \text{ lb-ft}$ )

C: 107.9 ~ 127.5 N.m (11.0 ~ 13.0 kgf.m, 79.6 ~ 94.0 lb-ft)



2. Remove the roll rod mounting suppot bracket (A).

Tightening torque

49.0 ~ 68.6 N.m (5.0 ~ 7.0 kgf.m, 36.2 ~ 50.6 lb-ft)

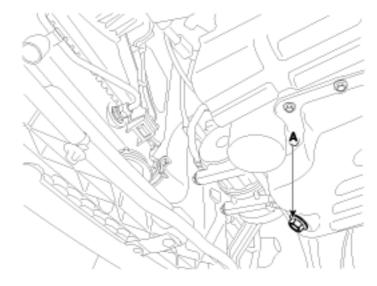


3. Installation is reverse order of removal.

### **ENGINE OIL AND FILTER REPLACEMENT**

## **▲** CAUTION

- Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.
- Exercise caution in order to minimize the length and frequency of contact of your skin to used oil. Wear protective clothing and gloves. Wash your skin thoroughly with soap and water, or use water-less hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.
- In order to preserve the environment, used oil and used oil filter must be disposed of only at designated disposal sites.
- 1. Drain the engine oil.
  - (1) Remove the oil filler cap.
  - (2) Remove the oil drain plug (A) and drain the oil into a container.



(3) Clean and install the oil drain plug with a new gasket.

#### **Tightening torque:**

34.3 ~ 44.1 N.m (3.5 ~ 4.5 kgf.m, 25.3 ~ 32.5 lb-ft)

- 2. Replace the oil filter.
  - (1) Remove the oil filter (A) with the SST (09263-02000).
  - (2) Check and clean the oil filter installation surface.
  - (3) Check the part number of the new oil filter is as same as old one.
  - (4) Apply clean engine oil to the gasket of a new oil filter.
  - (5) Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.
  - (6) Tighten it with the torque below.

#### **Tightening torque:**

11.8 ~ 15.7 N.m (1.2 ~ 1.6 kgf.m, 8.7 ~ 11.6 lb-ft)



3. Fill with new engine oil, after removing the engine oil level gauge.

#### Oil capacity

Total: 3.55 L (0.93 U.S.gal., 3.75 U.S.qt., 3.12 lmp.qt.) Oil pan: 3.3 L (0.87 U.S.gal., 3.48 U.S.qt., 2.90 lmp.qt.)

Drain and refill including oil filter

Except India:

3.5 L (0.92 U.S.gal., 3.70 U.S.qt., 3.08 lmp.qt.)

For India:

3.6 L (0.10 U.S.gal., 3.80 U.S.qt., 3.17 Imp.qt.)

- 4. Install the oil filler cap.
- 5. Start engine and check for oil leaks.
- 6. Recheck the engine oil level.

#### INSPECTION

1. Check the engine oil quality.

Check for oil deterioration, entry of water, discoloring of thinning.

If the quality is visibly poor, replace the oil.

2. Check the engine oil level.

After warming up the engine for five minutes, stop the engine and check the oil level. The level should be between the "L" and "F" marks on the dipstick.

If low, check for oil leakage and add oil up to the "F" mark on the dipstick.

### Selection of Engine Oil

#### Recommendation

For all except Middle East, India and Europe:

ACEA A5, API SM or above / 5W-30

For Middle East, India and Europe:

ACEA A5, API SM or above / 5W-30

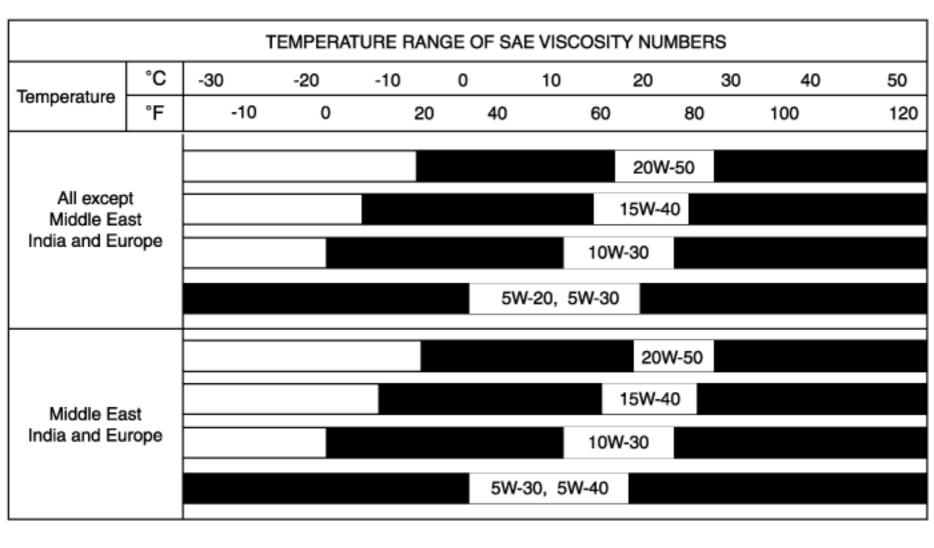
#### Allowed Oil Grade

API SL, SM or above

ILSAC GF-3, GF4 or above

ACEA A3, A5 or above

Allowed SAE Viscosity



### **REMOVAL AND INSTALLATION**

1. Remove the engine room under cover (A) and side cover (B).

### **Tightening torque:**

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)



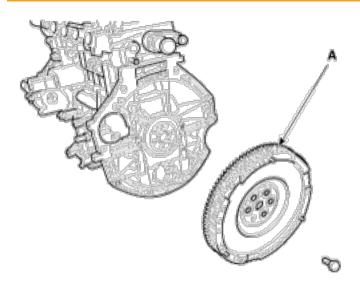
2. Installation is reverse order of removal.

### **REMOVAL**

- Remove the manual Transaxle.
   (Refer to Manual Transaxle System "Manual Transaxle")
- 2. Remove the flywheel (A).

### Tightening torque:

68.6 ~ 78.5 N.m (7.0 ~ 8.0 kgf.m, 50.6 ~ 57.9 lb-ft)



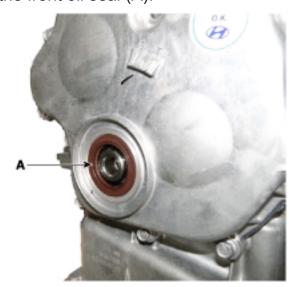
# NOTICE

Do not reuse the bolts.

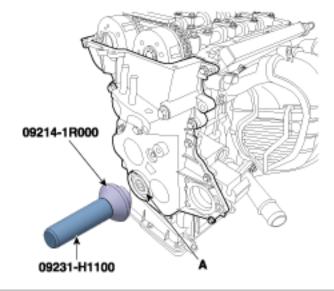
3. Install in the reverse order of removal.

### **REMOVAL AND INSTALLATION**

- Remove the crankshaft damper pulley.
   (Refer to Timing System "Crankshaft Damper Pulley")
- 2. Remove the front oil seal (A).



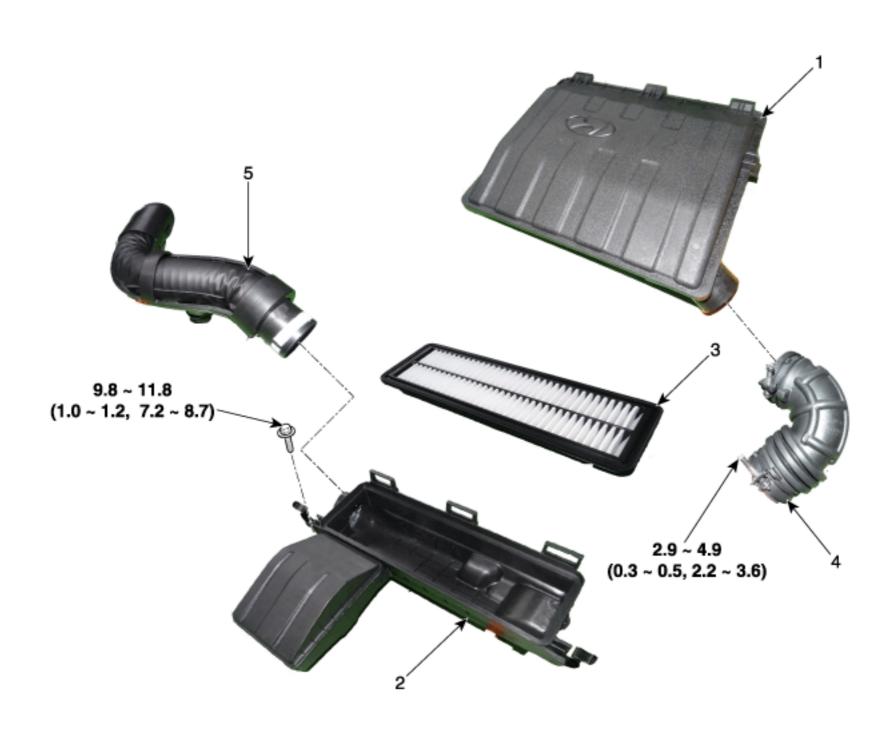
3. Using the SST (09214-1R100, 09231-H1100) (A), install a new front oil seal (B).



### NOTICE

Do not reuse the front oil seal.

### **COMOINENTS**



# Torque: N.m (kgf.m, lb-ft)

- 1. Air cleaner upper cover
- 2. Air cleaner lower cover
- 3. Air cleaner element

- 4. Intake hose
- 5. Air duct

#### REMAVAL AND INSTALLATION

### Air Cleaner Assembly

- 1. Remove the resonator.
  - (1) Disconnect the breather hose (A)
  - (2) Disconnect the intake hose (B)
  - (3) Remove the resonator (C)

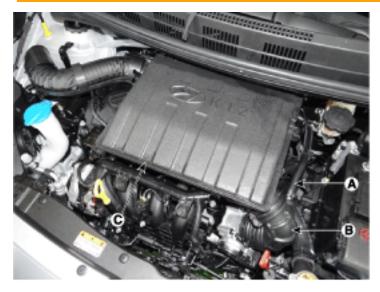
### **Tightening torque**

Hose clamp:

 $2.9 \sim 4.9 \text{ N.m} (0.3 \sim 0.5 \text{ kgf.m}, 2.2 \sim 3.6 \text{ lb-ft})$ 

Resonator bolts:

 $7.8 \sim 9.8 \text{ N.m} (0.8 \sim 1.0 \text{ kgf.m}, 5.8 \sim 7.2 \text{ lb-ft})$ 



2. Remove the air cleaner assembly (A).



3. Install in the reverse order of removal.

### Air Cleaner Element Replacement

- 1. Remove the resonator.
  - (1) Disconnect the intake hose clamp (A)
  - (2) Remove the air cleaner upper cover (B)

### Tightening torque:

 $2.9 \sim 4.9 \text{ N.m} (0.3 \sim 0.5 \text{ kgf.m}, 2.2 \sim 3.6 \text{ lb-ft})$ 

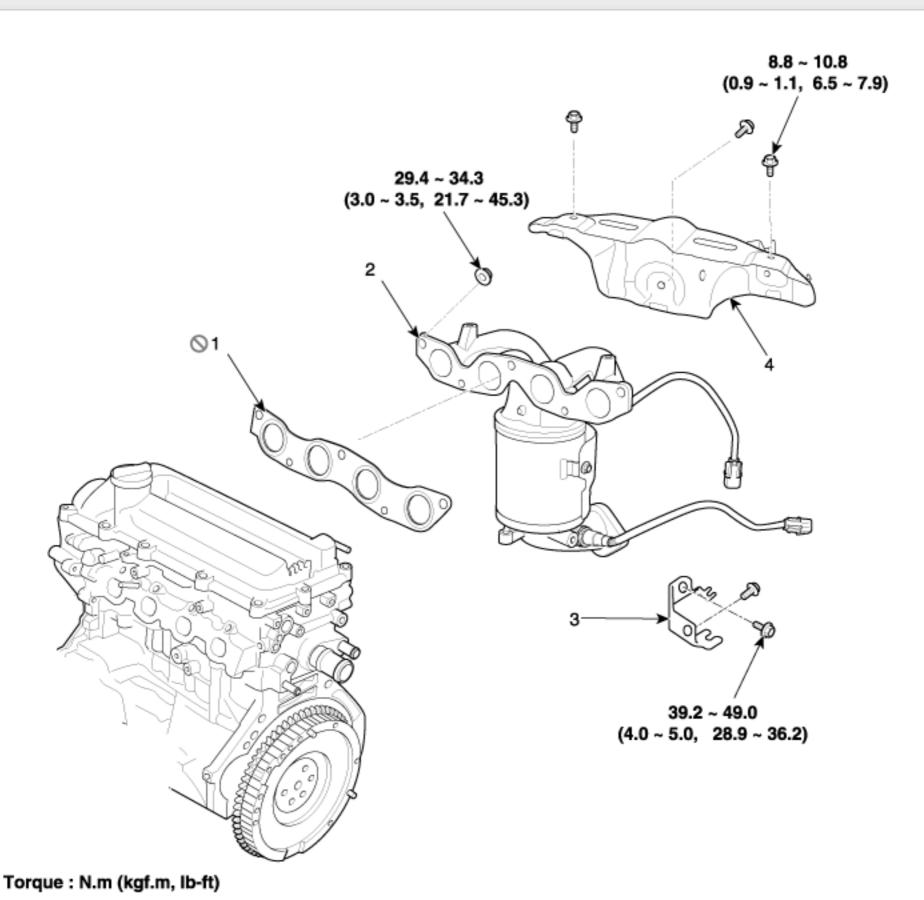


2. Remove the air cleaner element replacement (A).



3. Install in the reverse order of removal.

### **COMPONENTS**



1. Exhaust manifold gasket

2. Exhaust manifold assembly

- 3. Exhaust manifold stay
- 4. Heat protector

#### **REMOVAL AND INSTALLATION**

1. Disconnect the negative battery terminal.

#### **Tightening torque**

Without battery sensor:

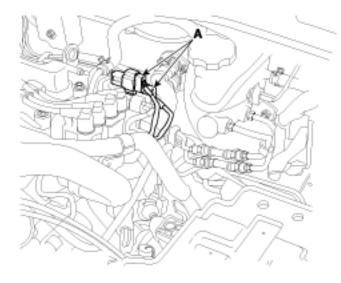
 $7.8 \sim 9.8 \text{ N.m}$  (0.8 ~ 1.0 kgf.m,  $5.8 \sim 7.2 \text{ lb-ft}$ )

With battery sensor:

 $4.0 \sim 6.0 \text{ N.m} (0.4 \sim 0.6 \text{ kgf.m}, 3.0 \sim 4.4 \text{ lb-ft})$ 

Remove the air cleaner assembly. (Refer to Engine and Transaxle Assembly)

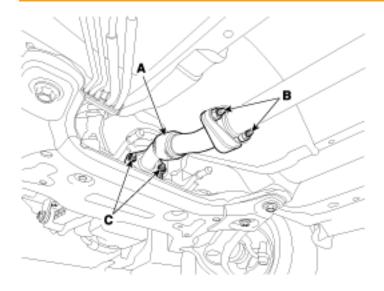
3. Disconnect the front/rear oxygen sensor connector (A).



4. Remove the front muffler (A).

### **Tightening torque:**

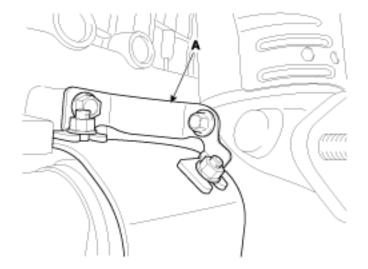
39.2 ~ 58.8 N.m (4.0 ~ 6.0 kgf.m, 28.9 ~ 43.4 lb-ft)



5. Remove the exhaust manifold stay (A).

### **Tightening torque:**

39.2 ~ 49.0 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.2 lb-ft)



6. Remove the heat protector (A).

### **Tightening torque:**

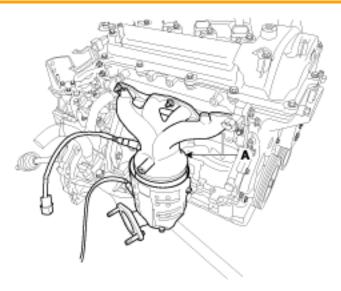
 $8.8 \sim 10.8 \text{ N.m} (0.9 \sim 1.1 \text{ kgf.m}, 6.5 \sim 7.9 \text{ lb-ft})$ 



7. Remove the exhaust manifold (A).

### **Tightening torque:**

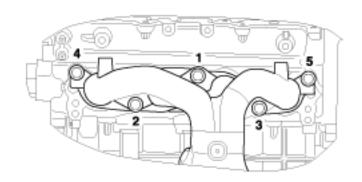
29.4 ~ 34.3 N.m (3.0 ~ 3.5 kgf.m, 21.7 ~ 25.3 lb-ft)



### NOTICE

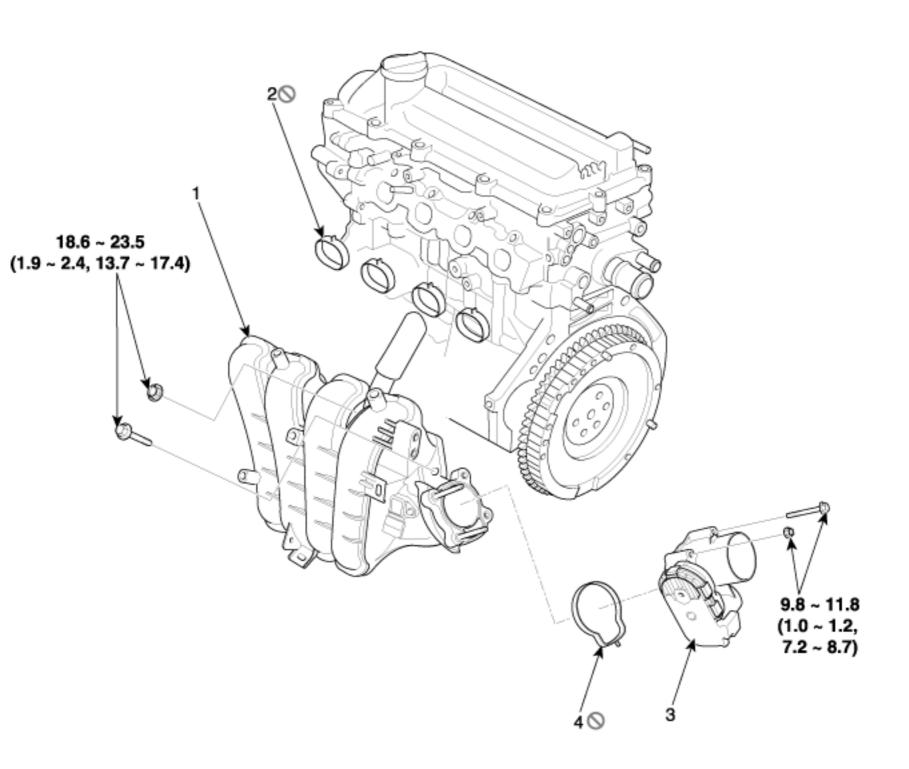
When installing, replace with a new gasket.

When installing the exhaust manifold, tighten the nuts with pre-torque first, and then tighten the nuts with specified torque in the sequence shown.



8. Install in the reverse order of removal.

### **COMPONENTS**



Torque: N.m (kgf.m, lb-ft)

1. Intake manifold

2. Intake manifold gasket

3. Throttle body

4. Throttle body gasket

#### REMOVAL AND INSTALLATION

1. Disconnect the negative battery terminal.

#### **Tightening torque**

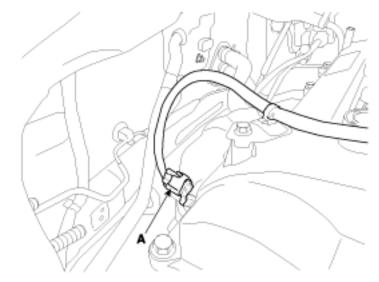
Without battery sensor:

 $7.8 \sim 9.8 \text{ N.m}$  (0.8 ~ 1.0 kgf.m,  $5.8 \sim 7.2 \text{ lb-ft}$ )

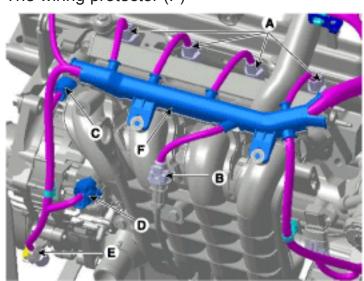
With battery sensor:

4.0 ~ 6.0 N.m (0.4 ~ 0.6 kgf.m, 3.0 ~ 4.4 lb-ft)

- Remove the air cleaner assembly. (Refer to Engine and transaxle assembly in this group)
- 3. Disconnect the wiring connectors and harness clamps, and remove the wiring and protectors from the cylinder head and intake manifold.
  - (1) The OCV(Oil Control Valve) connector (A)

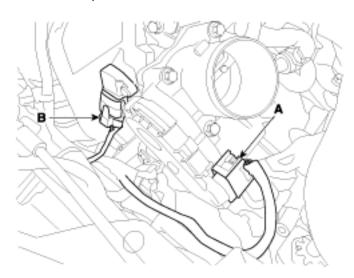


- (2) The injector connectors (A)
- (3) The knock sensor connector (B)
- (4) The intake OCV(Oil Control Valve) connector (C)
- (5) The alternator connector (D)
- (6) The air compressor switch connector (E)
- (7) The wiring protector (F)



(8) The ETC (Electronic Throttle Control) connector (A)

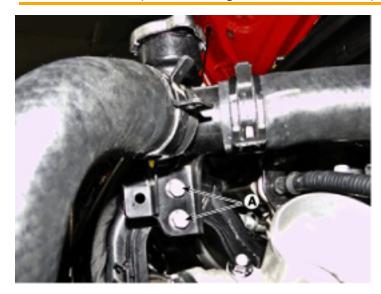
(9) The MAPS (Manifold Absolute Pressure Sensor) connector (B)



4. Unfasten the filler neck bolts (A).

### **Tightening torque:**

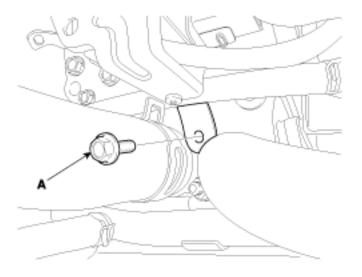
6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)



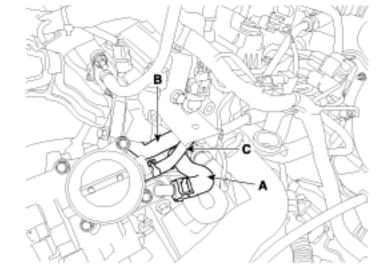
5. Unfasten the vacuum pipe fixing bolt (A).

### Tightening torque:

18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)



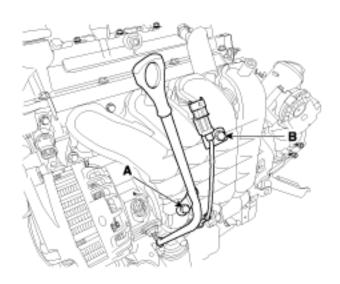
- 6. Disconnect the throttle body coolant hoses (A). (if equipped)
- 7. Disconnect the brake booster vacuum hose (B), the PCSV (Purge Control Solenoid Valve) hose (C).



8. Remove the oil level gauge (A), the knock sensor bracket (B).

### Tightening torque:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



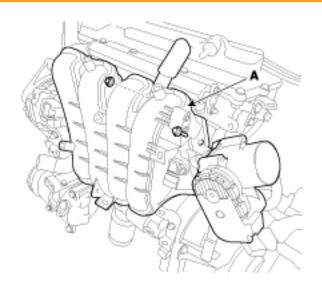
# NOTICE

When assemble the oil level gauge, put oil on the O-ring of that.

9. Remove the intake manifold (A).

### **Tightening torque:**

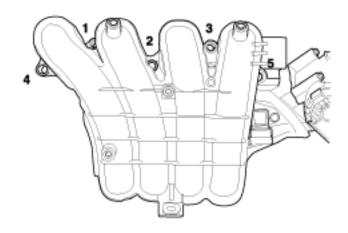
18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)



### NOTICE

When installing, replace with new gaskets.

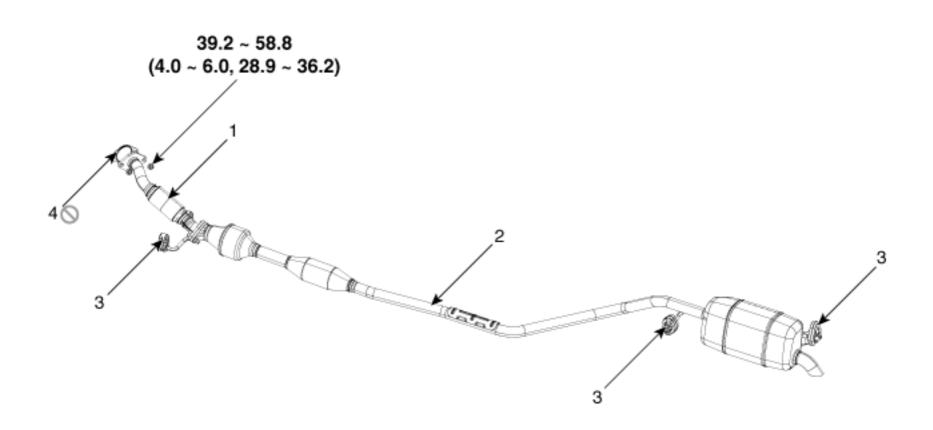
When installing the intake manifold, tighten the bolts and nuts with pre-torque first, and then tighten the bolts and nuts with specified torque in the sequence shown.



10. Install in the reverse order of removal.

### **COMPONENTS**

# [EURO 6]



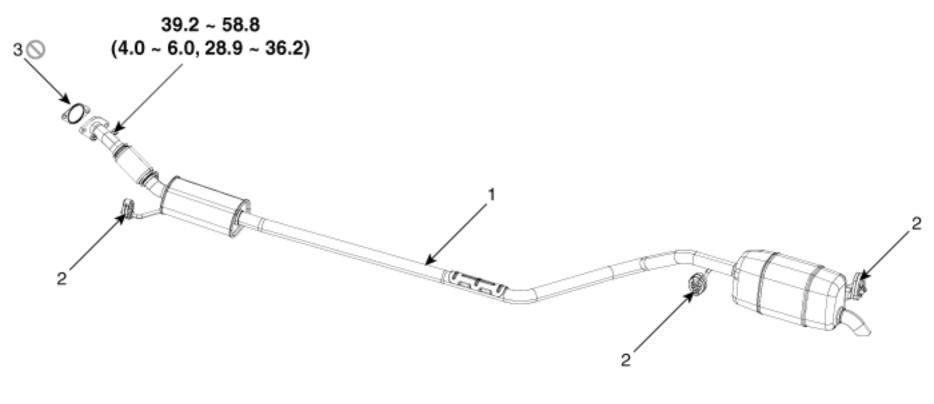
Tightening torque: N.m (kgf.m, lb-ft)

<ol> <li>Front muffle</li> </ol>	r
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3. Hanger

2. Center muffler & Main muffler assembly

4. Gasket



# Tightening torque : N.m (kgf.m, lb-ft)

1. Muffler assembly	3. Gasket
2. Hanger	

### **REMOVAL AND INSTALLATION**

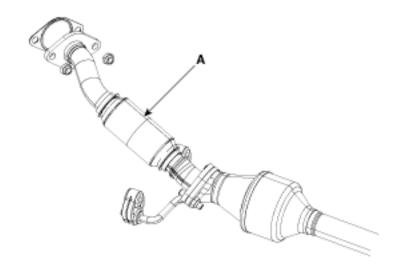
### [EURO 6]

# Front Muffler

1. Remove the front muffler (A).

### Tightening torque:

40.0 ~ 60.0 N.m (4.1 ~ 6.1 kgf.m, 29.5 ~ 44.3 lb-ft)



2. Install in the reverse order of removal.

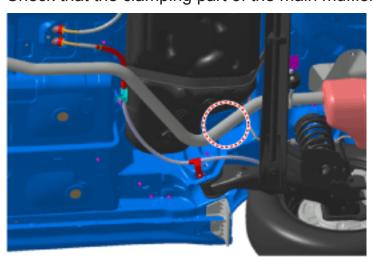
### NOTICE

Always use new gaskets.

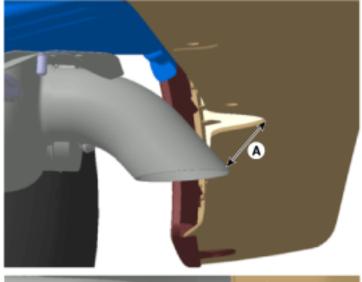
# Center Muffler & Main Muffler Assembly

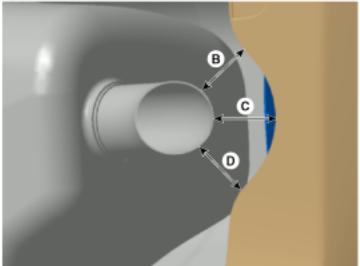
# Replacing procedures of catalytic converter using clamp

1. Check that the clamping part of the main muffler assembly is damaged or deformed.



2. Record the gap (A, B, C, D) between the tail pile and the rear bumper.

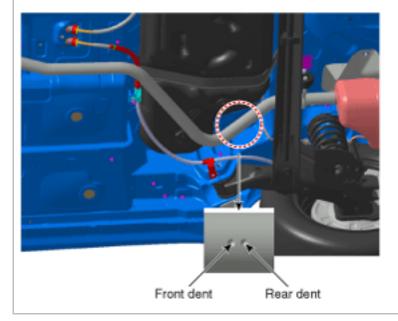




3. Cut the main muffler as indicated below.

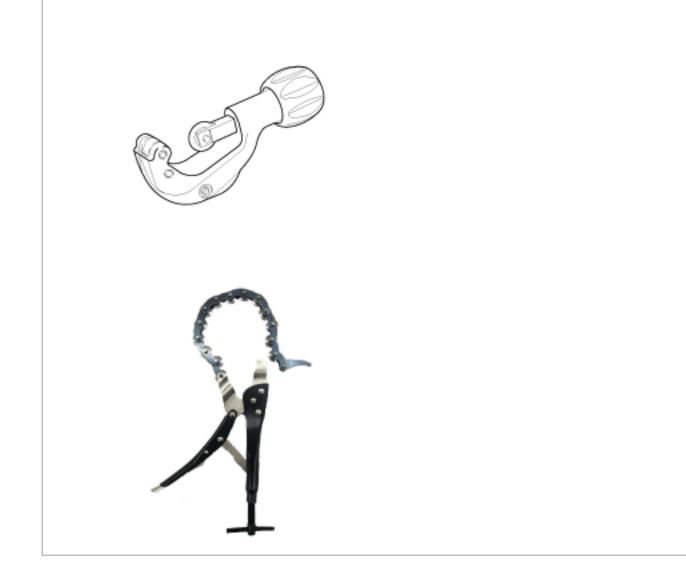
### NOTICE

- Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.
- Cut the muffler pipe marked with the rear dent.

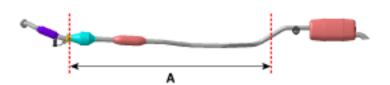


# i Information

• Use a pipe cutter or chain pipe cutter to make sure the cutting surface is smooth and even.

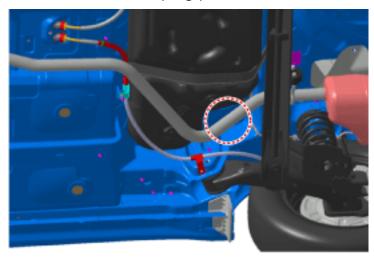


4. Replace the catalytic converter and center muffler (A) as shown in the image below. (Refer to the clamp installation procedures)

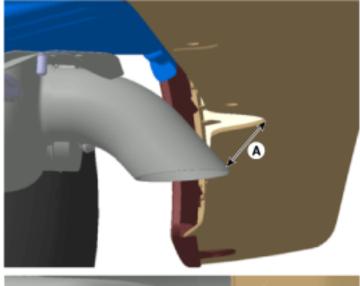


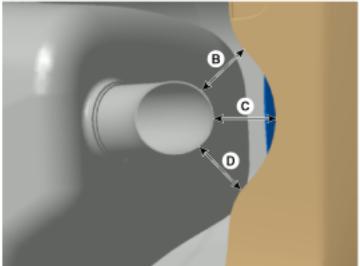
# Replacing procedures of center muffler including catalytic converter using clamp

1. Check that the clamping part of the main muffler assembly is damaged or deformed.



2. Record the gap (A, B, C, D) between the tail pile and the rear bumper.

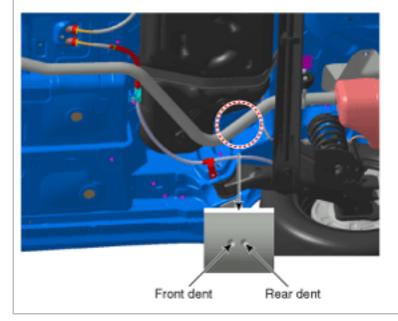




3. Cut the main muffler as the indicated below.

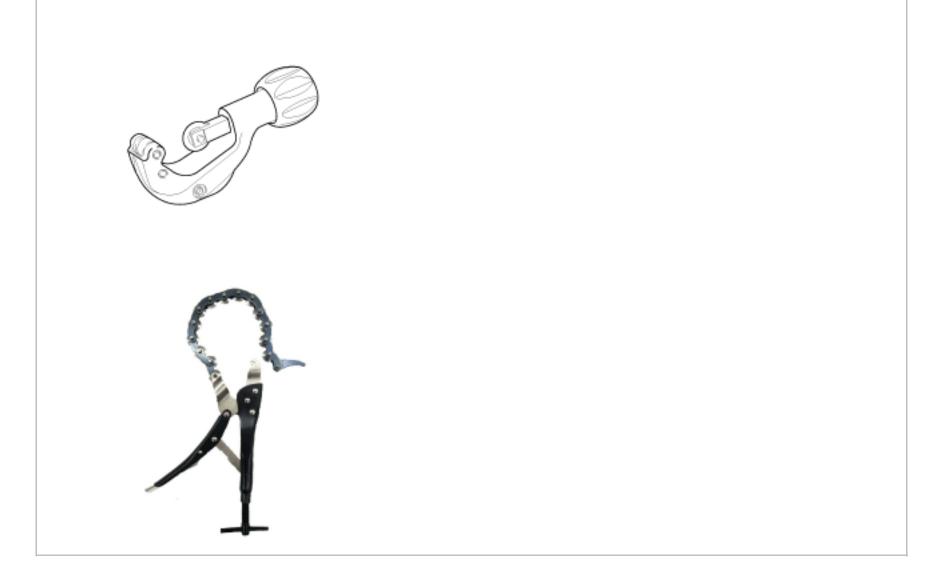
### NOTICE

- Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.
- Cut the muffler pipe marked with the rear dent.

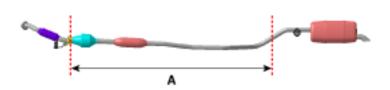


# i Information

• Use a pipe cutter or chain pipe cutter to make sure the cutting surface is smooth and even.



4. Replace the catalytic converter and center muffler (A) as shown in the image below. (Refer to the clamp installation procedures)

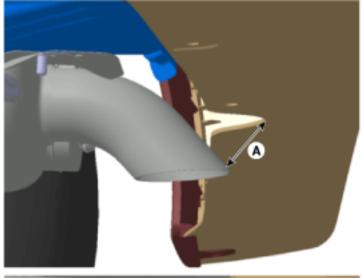


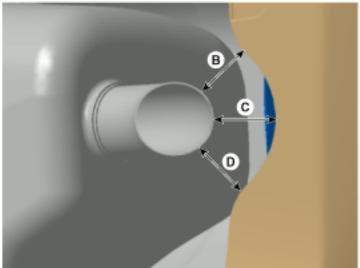
### Replacing procedures of center muffler without catalytic converter using clamp

1. Check that the clamping parts of the main and center muffler assembly.



2. Record the gap (A, B, C, D) between the tail pile and the rear bumper.

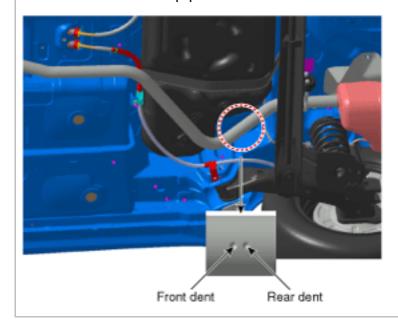




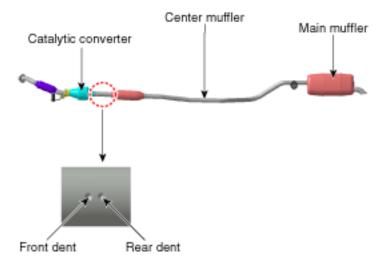
3. Cut the main muffler as indicated below.

# NOTICE

- Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.
- Cut the muffler pipe marked with the rear dent.



4. Cut the center muffler as indicated below.

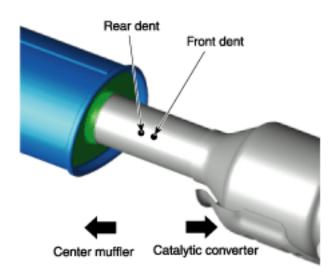


### NOTICE

• Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.

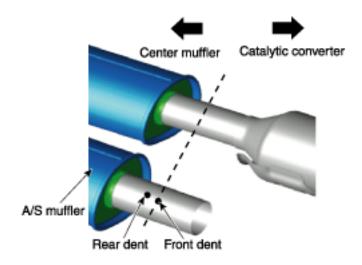
### [With dent]

Cut the muffler pipe marked with the front dent.



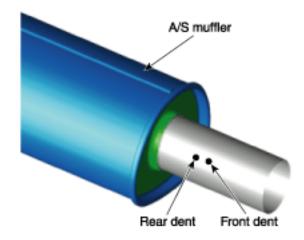
# [Without dent]

- Cut the muffler by reffering to the front dent of A/S muffler as shown in the image below.



# [A/S muffler]

- Cut the A/S muffler marked with the rear dent.



# NOTICE

- To prevent leaks, remove the rust on the clamping part or the burr on the cutting part.
- Cut the pipe vertically.

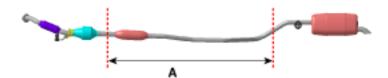
# information

• Use a pipe cutter or chain pipe cutter to make sure the cutting surface is smooth and even.



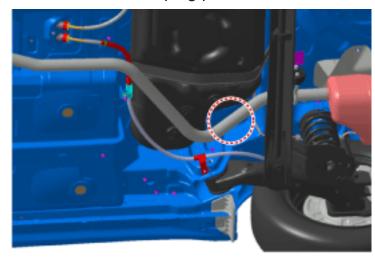


5. Replace the center muffler (A) as shown in the image below. (Refer to the clamp installation procedures)

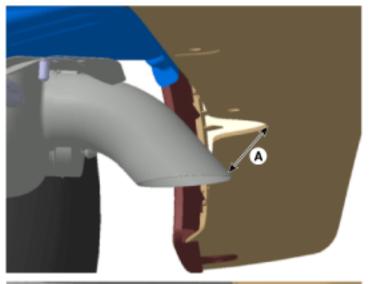


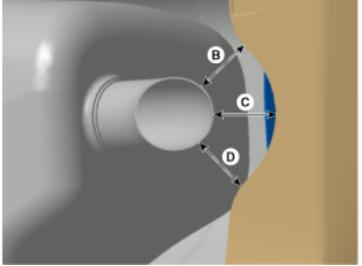
# Replacing procedures of main muffler using clamp

1. Check that the clamping part of the main muffler assembly is damaged or deformed.



2. Record the gap (A, B, C, D) between the tail pile and the rear bumper.

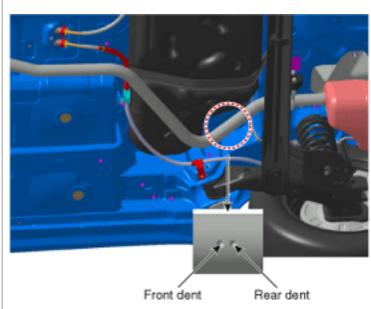




3. Cut the main muffler as indicated below.



- Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.
- Cut the muffler pipe marked with the front dent.



### i Information

• Use a pipe cutter or chain pipe cutter to make sure the cutting surface is smooth and even.



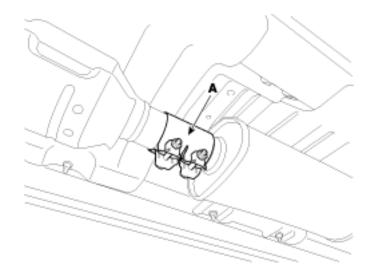


4. Replace the main muffler (A) as shown in the image below. (Refer to the clamp installation procedures)



### Clamp installation procedures when replacing the catalytic converter and center muffler

1. Put the clamp (A) between the cutting parts of the pipe and tighten the clamp lightly, not completely.

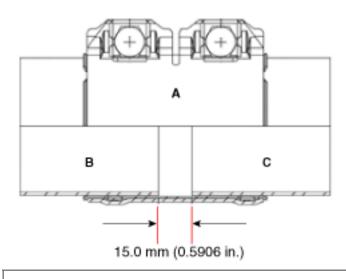


### NOTICE

Do not reuse the clamp that was tightened completely. If reused, the clamp may cause leaks.

#### NOTICE

In order to protect any leak from the clamp connection, the connection point of the two mufflers must be located within 7.5mm (0.3in.) from the clamp center line.



A: Clamp

B : Catalytic converter

C: Center muffler

2. Compare the gap between the tail pipe(or tail trim) and the rear bumper with the record measured before removing the center muffler assembly.

### NOTICE

If the tail pipe position is different from the initial position, the bumper may be damaged by the pipe heat and noise which arise from the interference between the tail pipe and the rear bumper.

3. Do not tighten the clamp by turning it once. Tighten the clamp nuts with the specified torque by alternately turning them a couple of times.

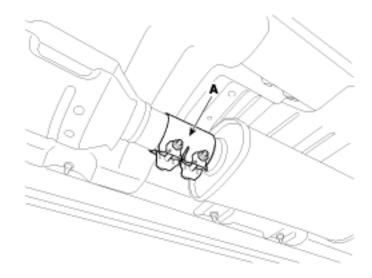
### Tightening torque:

[Part No: 28641-C8381]

41.2 ~ 54.9 N.m (4.2 ~ 5.6 kgf.m, 30.4 ~ 40.5 lb-ft)

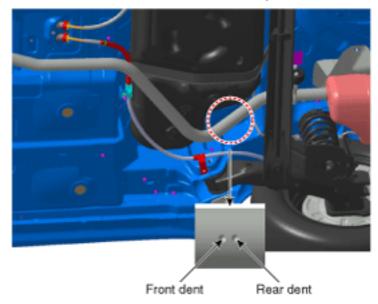
[Part No: 28641-C8420]

17.7 ~ 23.5 N.m (1.8 ~ 2.4 kgf.m, 13.0 ~ 17.4 lb-ft)



# Clamp installation procedures when replacing the main muffler and center muffler

1. Put the clamp between the cutting parts of the pipe and tighten the clamp lightly, not completely.

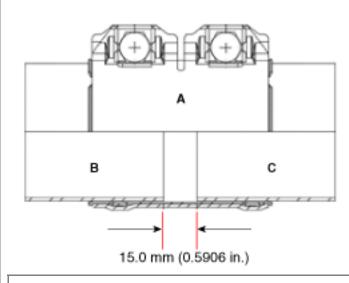


### NOTICE

Do not reuse the clamp that was tightened completely. If reused, the clamp may cause leaks.

### NOTICE

In order to protect any leak from the clamp connection, the connection point of the two mufflers must be located within 7.5mm (0.3in.) from the clamp center line.



A: Clamp

B : Center muffler C : Main muffler

2. Compare the gap between the tail pipe(or tail trim) and the rear bumper with the record measured before removing the center muffler assembly.

### NOTICE

If the tail pipe position is different from the initial position, the bumper may be damaged by the pipe heat and noise which arise from the interference between the tail pipe and the rear bumper.

3. Do not tighten the clamp by turning it once. Tighten the clamp nuts with the specified torque by alternately turning them a couple of times.

#### Tightening torque:

[Part No: 28641-C8381]

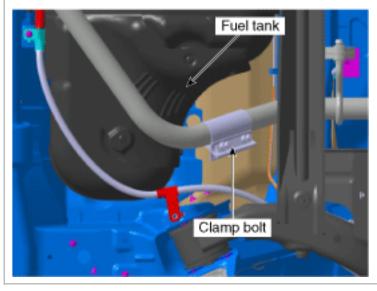
41.2 ~ 54.9 N.m (4.2 ~ 5.6 kgf.m, 30.4 ~ 40.5 lb-ft)

[Part No: 28641-C8420]

17.7 ~ 23.5 N.m (1.8 ~ 2.4 kgf.m, 13.0 ~ 17.4 lb-ft)

### **NOTICE**

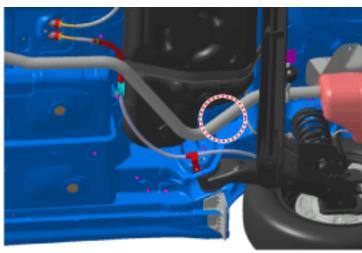
The clamp bolt should place opposite side of the fuel tank.



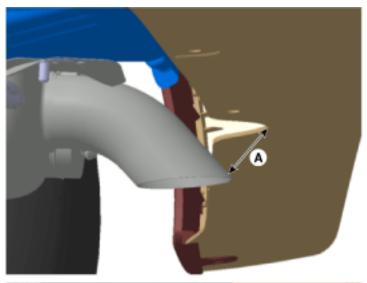
# [EURO 5]

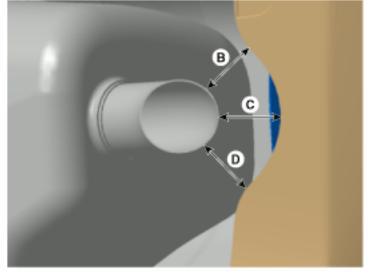
# Replacing procedures of front muffler & center muffler assembly using clamp

1. Check that the clamping part of the main muffler assembly is damaged or deformed.



2. Record the gap (A, B, C, D) between the tail pile and the rear bumper.

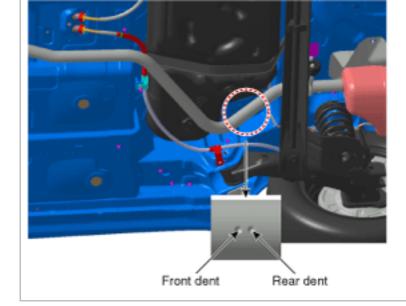




3. Cut the main muffler as indicated below.

### NOTICE

- Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.
- Cut the muffler pipe marked with the rear dent.



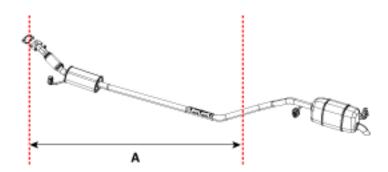
# 1 Information

• Use a pipe cutter or chain pipe cutter to make sure the cutting surface is smooth and even.





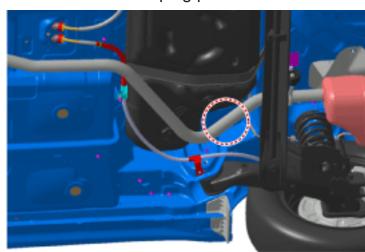
4. Replace the front muffler & center muffler assembly (A) as shown in the image below. (Refer to the clamp installation procedures).



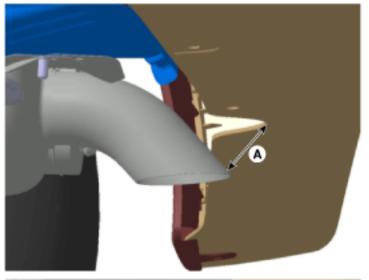
### Main muffler

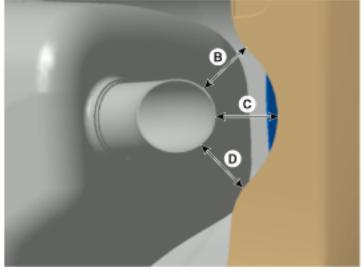
# Replacing procedures of main muffler using clamp

1. Check that the clamping part of the main muffler assembly is damaged or deformed.



2. Record the gap (A, B, C, D) between the tail pile and the rear bumper.

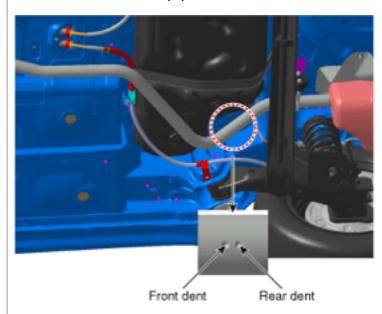




3. Cut the main muffler as indicated below.

### **NOTICE**

- Cut the part where the clamp is to be tightened while the muffler is installed in the vehicle.
- Cut the muffler pipe marked with the front dent.



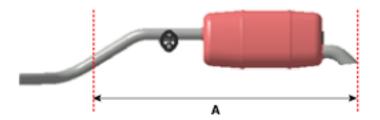


• Use a pipe cutter or chain pipe cutter to make sure the cutting surface is smooth and even.



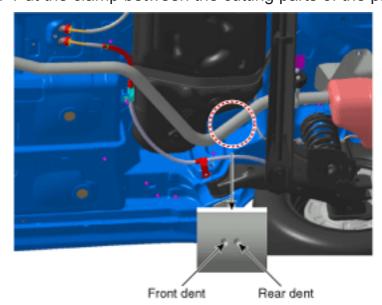


4. Replace the main muffler (A) as shown in the image below. (Refer to the clamp installation procedures)



# Clamp installation procedures when replacing the main muffler

1. Put the clamp between the cutting parts of the pipe and tighten the clamp lightly, not completely.

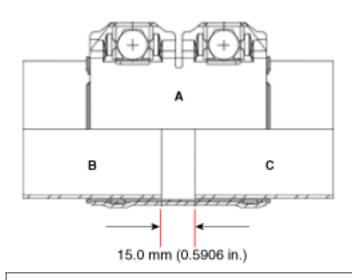


# NOTICE

Do not reuse the clamp that was tightened completely. If reused, the clamp may cause leaks.

# NOTICE

In order to protect any leak from the clamp connection, the connection point of the two mufflers must be located within 7.5mm (0.3in.) from the clamp center line.



A: Clamp

B: Center muffler

C: Main muffler

2. Compare the gap between the tail pipe(or tail trim) and the rear bumper with the record measured before removing

the center muffler assembly.

# **NOTICE**

- If the tail pipe position is different from the initial position, the bumper may be damaged by the pipe heat and noise which arise from the interference between the tail pipe and the rear bumper.
- 3. Do not tighten the clamp by turning it once. Tighten the clamp nuts with the specified torque by alternately turning them a couple of times.

# Tightening torque:

[Part No: 28641-C8381]

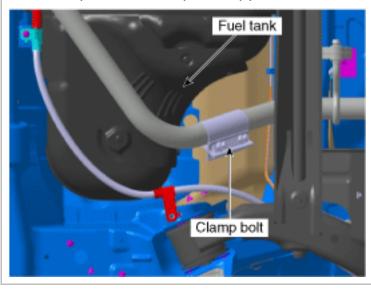
41.2 ~ 54.9 N.m (4.2 ~ 5.6 kgf.m, 30.4 ~ 40.5 lb-ft)

[Part No: 28641-C8420]

17.7 ~ 23.5 N.m (1.8 ~ 2.4 kgf.m, 13.0 ~ 17.4 lb-ft)

# NOTICE

The clamp bolt should place opposite side of the fuel tank.

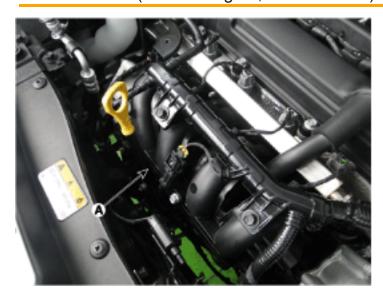


# **REMOVAL AND INSTALLATION**

1. 1. Remove the oil level gauge (A).

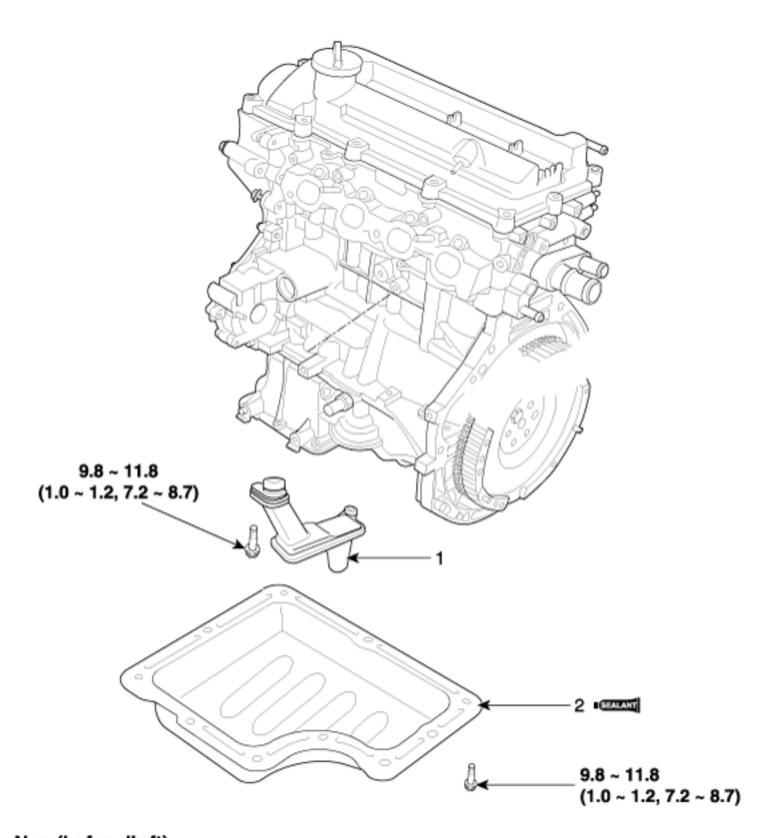
# Tightening torque:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



2. Install in the reverse order of removal.

# **COMPONENTS**

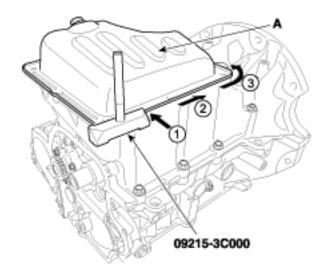


Torque : N.m (kgf.m, lb-ft)

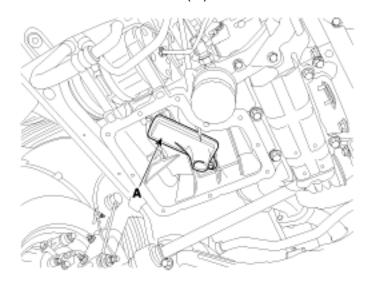
1. Oil screen 2. Oil pan

# **REMOVAL**

- Remove the under covers.
   (Refer to Engine and Transaxle Assembly "Engine Room Under Cover")
- Drain engine oil. (Refer to Lubrication System - "Engine Oil")
- Remove the oil pan (A).
   Insert the blade of SST (09215-3C000) between the ladder frame and the oil pan. Cut off applied sealer and remove the oil pan.



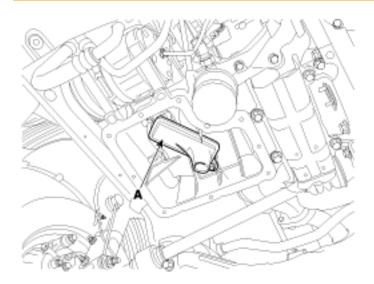
- Insert the SST between the ladder frame and the oil pan by tapping it with a plastic hammer in the direction of (1) arrow.
- After tapping the SST with a plastic hammer along the direction of (2) arrow around more than 2/3 edge of the oil pan, remove it from the oil pan.
- Do not turn over the SST abruptly without tapping. It be result in damage of the SST.
- Be careful not to damage the contact surfaces of ladder frame and oil pan.
- 4. Remove the oil screen (A).



1. Install the oil screen (A), with a new O-ring.

# Tightening torque:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

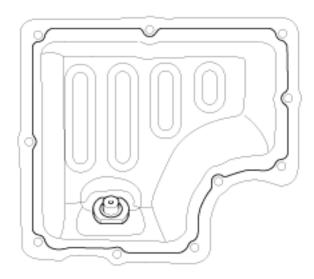


# NOTICE

Before installing the oil screen, apply a coat of engine oil to the O-ring.

- 2. Install the lower oil pan.
  - (1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
  - (2) Before assembling the oil pan, the liquid sealant TB1217H or LT5900H should be applied on lower oil pan. The part must be assembled within 5 minutes after the sealant was applied.

**Bead width:** 3.0 ~ 4.0 mm (0.12 ~ 0.16 in)



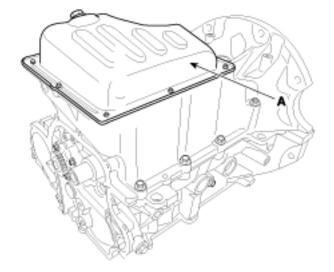
# **NOTICE**

- Clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant.
- When applying sealant gasket, sealant must not protrude into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.
- 3. Install the lower oil pan (A).

# **Tightening torque:**

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

Uniformly tighten the bolts in several passes.



# NOTICE

After assembly, wait at least 30 minutes before filling the engine with oil. Always use a new drain plug gasket.

4. Refill engine with engine oil.

# **REMOVAL AND INSTALLATION**

1. 1. Disconnect the oil pressure switch connector (A) and then remove the oil pressure switch (B).

# **Tightening torque:**

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft



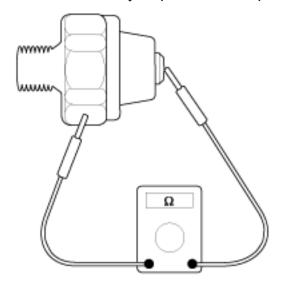
2. 2. Install in the reverse order of removal.

# NOTICE

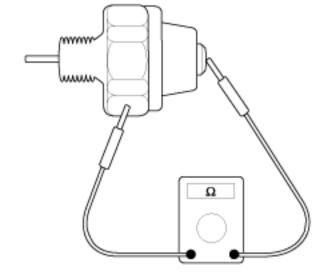
When installing the oil pressure switch, apply seal lock to the thread.

### INSPECTION

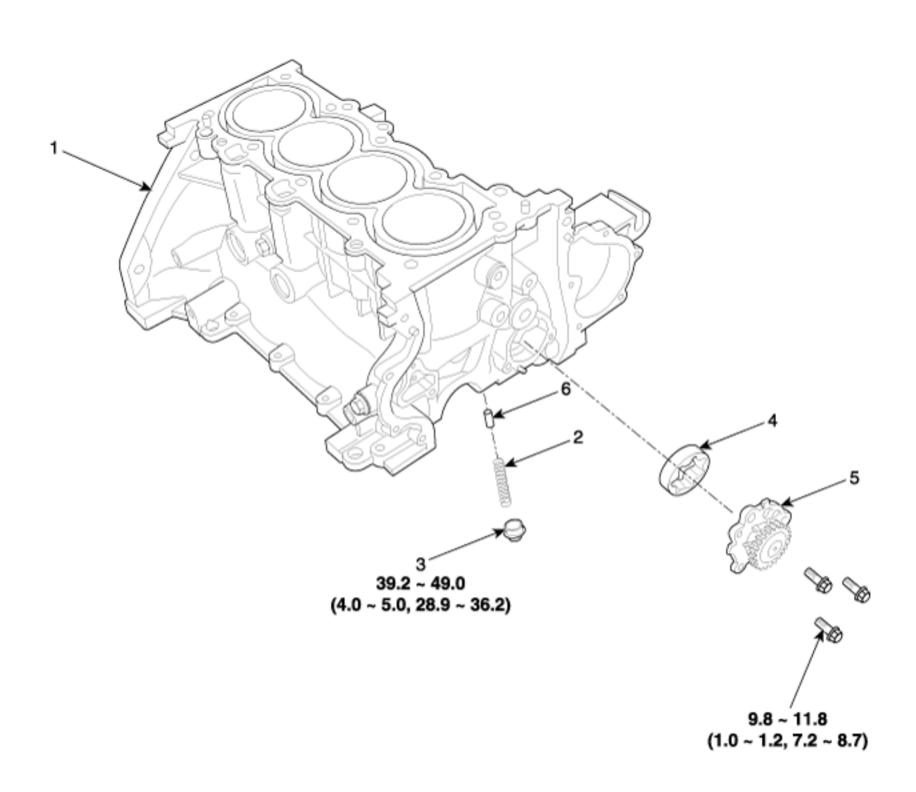
1. Check the continuity between the terminal and the body with an ohmmeter. If there is no continuity, replace the oil pressure switch.



- 2. Check the continuity between the terminal and the body when the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.
- 3. If there is no continuity when a 50kPa (0.50kgf/cm², 7.25psi) is applied through the oil hole, the switch is operaing properly.
  - Check for air leakage. If air leaks, the diaphragm is broken. Replace it.



# **COMPONENTS**

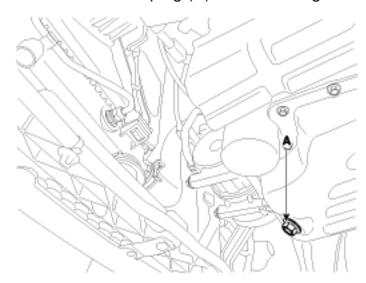


# Torque : N.m (kgf.m, lb-ft)

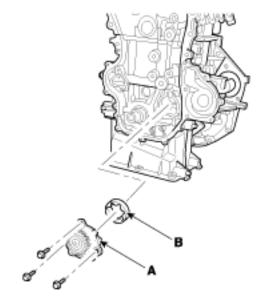
1. Cylinder block	4. Outer rotor
2. Relief spring	5. Oil pump
3. Relief plug	6. Relief plunger

# **REMOVAL**

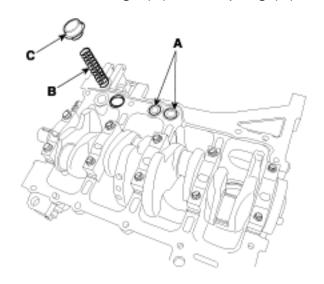
1. Remove the drain plug (A) and drain engine oil.



- 2. Remove the timing chain. (Refer to Timing System)
- 3. Remove the oil pump (A) and outer rotor (B) from the cylinder block.



- 4. Remove the ladder frame. (Refer to Cylinder Block)
- 5. Remove the O-rings (A), relief spring (B) and the relief valve (C).



1. Inspect the relief plunger.

Coat the plunger with engine oil and check that it falls smoothly into the plunger hole by its own weight. If it does not, replace the relief plunger. If necessary, replace the front case.

2. Inspect the relief valve spring.

Inspect for distorted or broken relief valve spring.

### Standard value

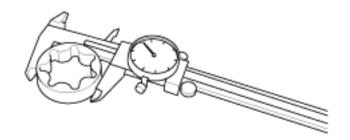
Free height: 58.3 mm (2.2952 in)

Load:

 $6.19 \pm 0.62 \text{ kg} / 39.5 \text{ mm} (60.7 \pm 6.1 \text{N} / 1.5551 \text{ in})$ 

 $9.48 \pm 0.95 \text{ kg} / 29.5 \text{ mm} (93.0 \pm 9.3 \text{N} / 1.1614 \text{ in})$ 

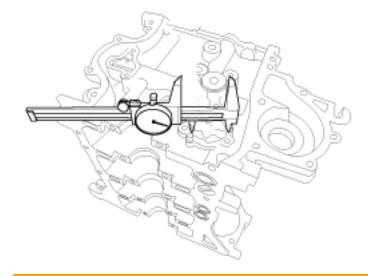
- 3. Inspect the rotor side clearance.
  - (1) Using a vernier calipers measure the diameter of outer rotor.



### Standard diameter:

46.781 ~ 46.820 mm (1.8417 ~ 1.8433 in)

(2) Using a vernier calipers measure the diameter of cylinder block oil pump hole.



## Standard diameter:

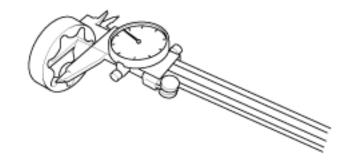
47.000 ~ 47.039 mm (1.8503 ~ 1.8519 in)

(3) Calculate the difference between the outer rotor and the cylinder block hole.

# **Standard clearance:**

0.180 ~ 0.258 mm (0.0071 ~0.0102 in)

- 4. Inspect the rotor width clearance.
  - (1) Using a vernier calipers measure the width of outer rotor.



# **Standard width:**

15.96 ~ 15.98 mm (0.6283 ~ 0.6291 in)

(2) Using a vernier calipers measure the diameter of cylinder block oil pump hole.



### Standard width:

16.02 ~ 16.05 mm (0.6307 ~ 0.6319 in)

(3) Calculate the difference between the outer lotor and the cylinder block hole.

### **Standard clearance:**

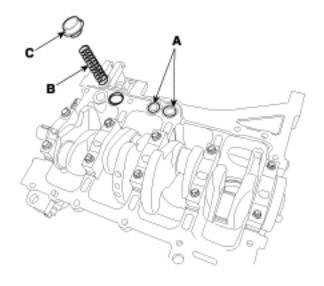
0.040 ~ 0.090 mm (0.0015 ~ 0.0035i n)

# **INSTALLATION**

1. Install the O-rings (A) and relief spring (B) the relief valve (C).

# **Tightening torque:**

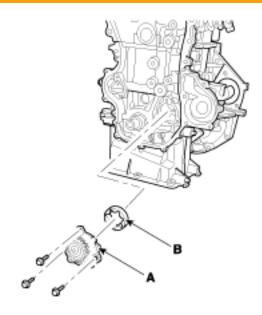
39.2 ~ 49.0 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.2 lb-ft)



- Install the ladder frame.(Refer to Cylinder block in this group)
- 3. Install the outer rotor (B) and the oil pump (A).

# Tightening torque:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft) -3EA

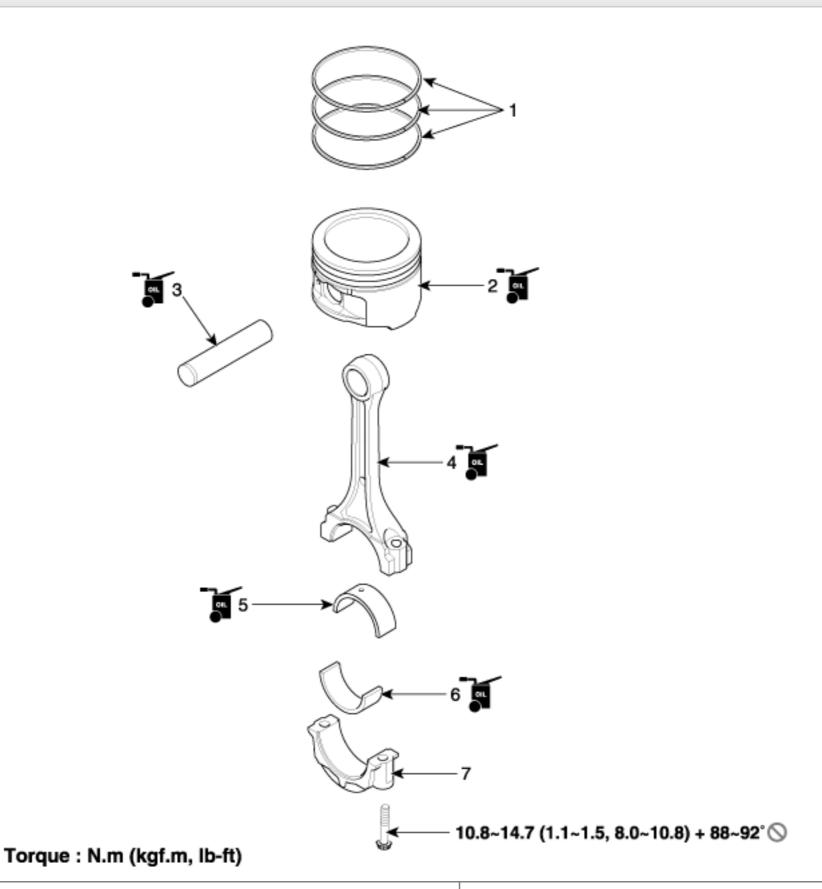


# NOTICE

Apply engine oil when rotor assemble.

- 4. Install the oil pump to true position of dowel pin & cover reamer hole when pump install.
- Install the timing chain.(Refer to Timing System)
- 6. Refill the engine oil.

# **COMPONENTS**



- 1. Piston ring
- 2. Piston
- 3. Piston pin
- 4. Connecting rod

- 5. Connecting rod upper bearing
- 6. Connecting rod lower bearing
- 7. Connecting rod cap

# **DISASSEMBLY**

# NOTICE

- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

# i Information

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No.1 piston is at TDC (Top dead center).
- Remove the engine assembly from the vehicle.
   (Refer to Engine and Transaxle Assembly "Engine and Transaxle Assembly")
- 2. Remove the transaxle assembly from the engine assembly.

Manual Transaxle.

(Refer to Manual Transaxle System - "Manual Transaxle")

Automatic Transaxle.

(Refer to Automatic Transaxle System - "Automatic Transaxle")

- 3. Manual Transaxle : Remove the flywheel.
  - (Refer to Cylinder Block "Flywheel")

Automatic Transaxle: Remove the drive plate.

(Refer to Cylinder Block - "Drive Plate")

- 4. Install the engine to engine stand for disassembly.
- 5. Remove the timing chain.

(Refer to Timing System - "Timing Chain")

6. Remove the intake manifold.

(Refer to Intake and Exhaust System - "Intake Manifold")

7. Remove the exhaust manifold.

(Refer to Intake and Exhaust System - "Exhaust Manifold")

8. Remove the cylinder head assembly.

(Refer to Cylinder Head Assembly - "Cylinder Head")

9. Remove the water pipe.

(Refer to Cooling System - "Water Pipe")

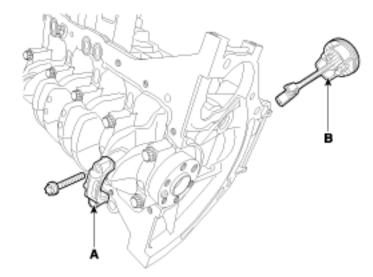
10. Remove the water temperature control assembly.

(Refer to Cooling System - "Water Temperature Control Assembly")

11. Remove the oil pan and oil screen.

(Refer to Lubrication System - "Oil Pan")

- Remove the ladder frame.
   (Refer to Cylinder Block "Cylinder Block")
- 13. Check the connecting rod end play.
- 14. Remove the connecting rod caps and check oil clearance.
- 15. Check the connecting rod cap oil clearance.
- 16. Remove the piston and connecting rod assemblies.
  - (1) Using a ridge reamer, remove all the carbon from the top of the cylinder.
  - (2) Remove the connecting rod cap (A).
  - (3) Push the piston, connecting rod assembly (B) and upper bearing through the top of the cylinder block.



# **NOTICE**

- Keep the bearings, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in the correct order.
- 17. Check fit between piston and piston pin.

Try to move the piston back and forth on the piston pin. If any movement is felt, replace piston and piston pin as a set.

- 18. Remove the piston rings.
  - (1) Using a piston ring expander, remove the 2 compression rings.
  - (2) Remove 2 side rails and the spacer by hand.

# NOTICE

Arrange the piston rings in the correct order only.

19. Remove the connecting rod from the piston.

Using a press, remove the piston pin from the piston.

**Press-in load**: 250 ~ 1050 kg (551 ~ 2315 lb)

# **INSPECTION**

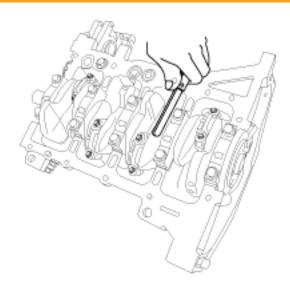
# **Connecting Rod**

1. Check the connecting rod end play.

Using a feeler gauge, measure the end play while moving the connecting rod back and forth.

### Standard end play:

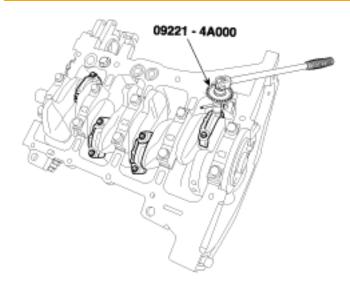
 $0.10 \sim 0.25 \text{ mm} (0.0039 \sim 0.0098 \text{ in})$ 



- (1) If out-of-tolerance, install a new connecting rod.
- (2) If still out-of-tolerance, replace the crankshaft.
- 2. Check the connecting rod bearing oil clearance.
  - (1) Check the match marks on the connecting rod and cap are aligned to ensure correct reassembly.
  - (2) Remove the 2 connecting rod cap bolts.
  - (3) Remove the connecting rod cap and lower bearing.
  - (4) Clean the crank pin journal and bearing.
  - (5) Place a plastigage across the crankshaft pin journal.
  - (6) Reinstall the lower bearing and cap, and tighten the bolts.

# Tightening torque:

10.8 ~ 14.7 N.m (1.1 ~ 1.5 kgf.m, 8.0 ~ 10.8 lb-ft) + 88 ~ 92°



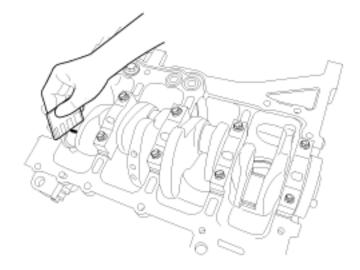
# NOTICE

Do not turn the crankshaft.

- (7) Remove the 2 bolts, connecting rod cap and lower bearing.
- (8) Measure the plastigage at its widest point.

### Standard oil clearance:

0.018 ~ 0.036 mm (0.0007 ~ 0.0014 in)



(9) If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark (Refer to connecting rod bearing selection table) Recheck the oil clearance.

# **▲** CAUTION

Do not file, shim, or scrape the bearings or the caps to adjust clearance.

(10) If the plastigage shows the clearance is still incorrect, try the next lager or smaller bearing. (Refer to connecting rod bearing selection table Recheck the oil clearance.

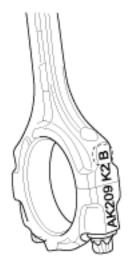
# NOTICE

If the proper clearance cannot be obtained by using the appropriate lager or smaller bearings, replace the crankshaft and start over.

# **▲** CAUTION

If the alignment marks are unreadable because of an accumulation of grease or grime, don't clean with a wire or abrasive cleaner. Clean only with correct cleaning solvent or detergent.

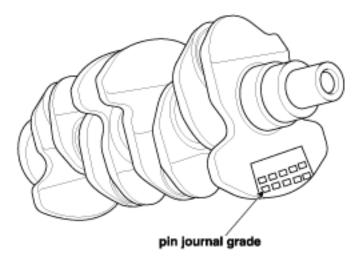
# **Connecting Rod Mark Location**



# **Discrimination of Connecting Rod**

Grade	Mark	Connecting Rod Big-end Inner Diameter
0	А	42.000 ~ 42.006 mm (1.6535 ~ 1.6540 in)
1	В	42.006 ~ 42.012 mm (1.6537 ~ 1.6540 in)
2	С	42.012 ~ 42.018 mm (1.6540 ~ 1.6542 in)

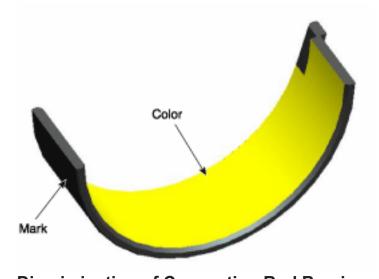
# **Crankshaft Pin Journal Mark Location**



# **Discrimination of Crankshaft Pin Journal**

Class	Mark	Crankshaft Pin Journal outer Diameter
ı	1	38.966 ~ 38.972 mm (1.5340 ~ 1.5343 in)
II	2	38.960 ~ 38.966 mm (1.5338 ~ 1.5340 in)
III	3	38.954 ~ 38.960 mm (1.7698 ~ 1.7701 in)

# **Connecting Rod Bearing Mark Location**



# **Discrimination of Connecting Rod Bearing**

Grade	Color	Connecting Rod Bearing Thickness
А	Blue	1.514 ~ 1.517 mm (0.0596 ~ 0.0597 in)
В	Black	1.511 ~ 1.514 mm (0.0595 ~ 0.0596 in)
С	None	1.508 ~ 1.511 mm (0.0594 ~ 0.0595 in)
D	Green	1.505 ~ 1.508 mm (0.0593 ~ 0.0594 in)
Е	Yellow	1.502 ~ 1.505 mm (0.0591 ~ 0.0593 in)

# (11) Select the bearing by using selection table.

# **Connecting Rod Bearing Selection Table**

Connecting R	od Bearing	0 (A)	1 (B)	2 (C)
Crank shaft pin journal mark	I (1)	E (Yellow)	D (Green)	C (None)
	II (2)	D (Green)	C (None)	B (Black)
	III (3)	C (None)	B (Black)	A (Blue)

# **Piston**

- 1. Clean the piston
  - (1) Using a gasket scraper, remove the carbon from the piston top.
  - (2) Using a groove cleaning tool, clean the piston ring grooves.
  - (3) Using solvent and a brush, thoroughly clean the piston.

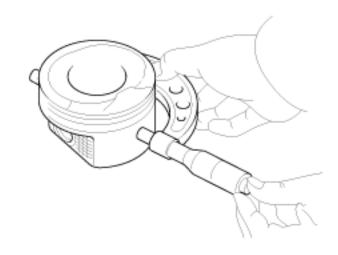


Do not use a wire brush.

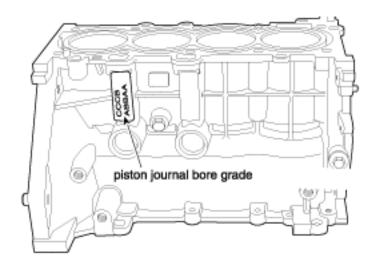
2. The standard measurement of the piston outside diameter is taken 30.0mm (1.21in) from top land of the piston.

### Standard diameter:

70.970 ~ 71.000 mm (2.7940 ~ 2.7952 in)



3. Check the cylinder bore size code on the cylinder block.

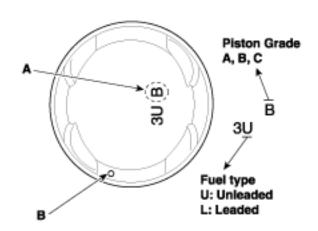


# Discrimination of cylinder bore size

Grade	Size code	Cylinder Bore inner Diameter
а	А	71.00 ~ 71.01 mm (2.7952 ~ 2.7956 in)
		71.01 ~ 71.02 mm

þ	В	(2.7956 ~ 2.7960 in)
С	С	71.02 ~ 71.03 mm (2.7960 ~ 2.7964 in)

4. Check the piston size code (A) and the front mark (B) on the piston top face.



### **Discrimination of Piston Outer Diameter**

Grade	Size code	Piston Outer Diameter
а	A	70.970 ~ 70.980 mm (2.7940 ~ 2.7944 in)
b	В	70.980 ~ 70.990 mm (2.7944 ~ 2.7948 in)
С	С	70.990 ~ 71.000 mm (2.7948 ~ 2.7952 in)

5. Select the piston related to cylinder bore class.

# Clearance:

0.02 ~ 0.04 mm (0.0008 ~ 0.0016 in)

# **Piston Rings**

1. Calculate the difference between the cylinder bore diameter and the piston diameter.

# Piston-to-cylinder clearance:

 $0.02 \sim 0.04 \text{ mm} (0.0008 \sim 0.0016 \text{ in})$ 

2. Inspect the piston ring side clearance.

Using a feeler gauge, measure the clearance between new piston ring and the wall of the ring groove.

# Piston ring groove width

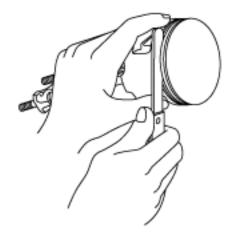
No.1 : 1.035 ~ 1.05 mm (0.0407 ~ 0.0413 in) No.2 : 1.23 ~ 1.25 mm (0.0484 ~ 0.0492 in) Oil ring : 2.01 ~ 2.025 mm (0.0791 ~0.0797 in)

### Piston ring width

No.1: 0.97~ 0.985 mm (0.0381 ~ 0.0387 in) No.2: 1.17 ~ 1.19 mm (0.0460 ~ 0.0468 in) Oil ring: 1.91 ~ 1.97 mm (0.0751 ~ 0.0775 in)

### Piston ring side clearance

No.1: 0.05 ~ 0.08 mm (0.0019 ~ 0.0031 in) No.2: 0.04 ~ 0.08 mm (0.0015 ~ 0.0031 in) Oil ring: 0.04 ~ 0.115 mm (0.0015 ~0.0045 in)



If the clearance is greater than maximum, replace the piston.

# 3. Inspect piston ring end gap.

To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring. If the gap is too large, recheck the cylinder bore diameter against the wear limits. If the bore is over the service limit, the cylinder block must be replaced.

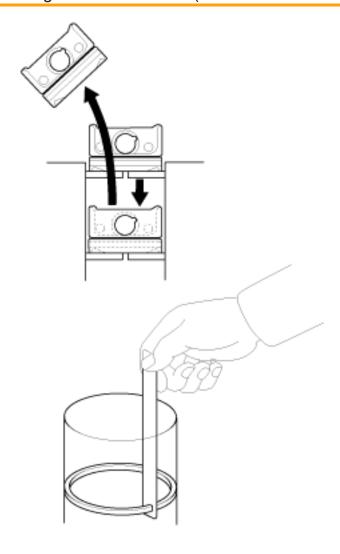
# Piston ring end gap

No.1

 $0.13 \sim 0.25 \text{ mm} (0.0051 \sim 0.0098 \text{ in})$ 

No.2:  $0.30 \sim 0.45 \text{ mm} (0.0118 \sim 0.0177 \text{ in})$ 

Oil ring :  $0.10 \sim 0.40 \text{ mm} (0.0039 \sim 0.0157 \text{ in})$ 



# **Piston Pins**

1. Measure the diameter of the piston pin.

# Piston pin outer diameter:

18.000 ~ 18.003 mm (0.7086 ~ 0.7087 in)

# Piston pin hole diameter:

18.013 ~ 18.017 mm (0.7092 ~ 0.7093 in)

# Connecting rod small end inner diameter:

17.974 ~ 17.985 mm (0.7076 ~ 0.7080 in)



2. Measure the piston pin-to-piston clearance.

# Piston pin-to-piston clearance:

 $0.010 \sim 0.017 \text{ mm} (0.00039 \sim 0.00067 \text{ in})$ 

3. Check the difference between the piston pin outer diameter and the connecting rod small end inner diameter.

# Piston pin-to-connecting rod interference:

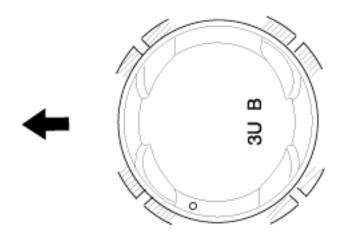
 $0.015 \sim 0.029 \text{ mm} (0.0006 \sim 0.0014 \text{ in})$ 

### REASSEMBLY

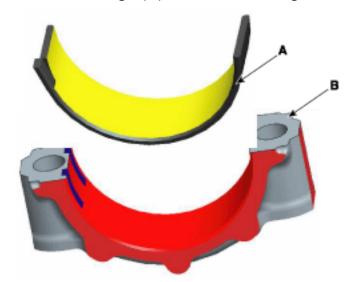
- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.
- 1. Assemble the piston and connecting rod.
  - (1) Use a hydraulic press for installation.
  - (2) The piston front mark and the connecting rod front mark must face the timing belt side of the engine.



- 2. Install the piston rings.
  - (1) Install the oil ring expender and 2 side rails by hand.
  - (2) Using a piston ring expender, install the 2 compression rings with the code mark facing upward.
  - (3) Position the piston rings so that the ring ends are as shown.

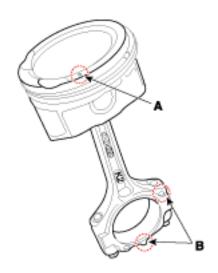


- 3. Install the connecting rod bearings.
  - (1) Align the bearing claw with the groove of the connecting rod and connecting rod cap.
  - (2) Install the bearings (A) in the connecting rod and connecting rod cap (B).



4. Install the piston and connecting rod assemblies.

- Before installing the pistons, apply a coat of engine oil to the ring grooves and cylinder bores.
- The piston front mark (A) and the connecting rod front mark (B) must face the timing chain side of the engine.

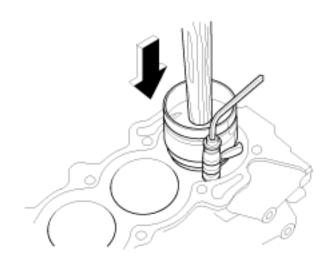


- (1) Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.
- (2) Stop after the ring compressor pops free, and check the connecting rod to check journal alignment before pushing the piston into place.

(3) Apply engine oil to the bolt threads. Install the rod caps with bearings, and tighten the bolts.

# NOTICE

- Always use new connecting rod bearing cap bolts.
- Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.

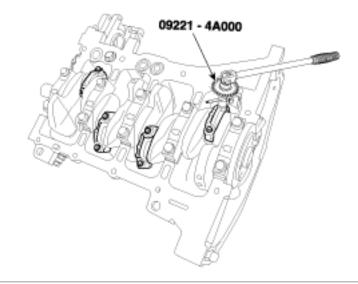


# Tightening torque:

10.8 ~ 14.7 N.m (1.1 ~ 1.5 kgf.m, 8.0 ~ 10.8 lb-ft) + 88 ~ 92°

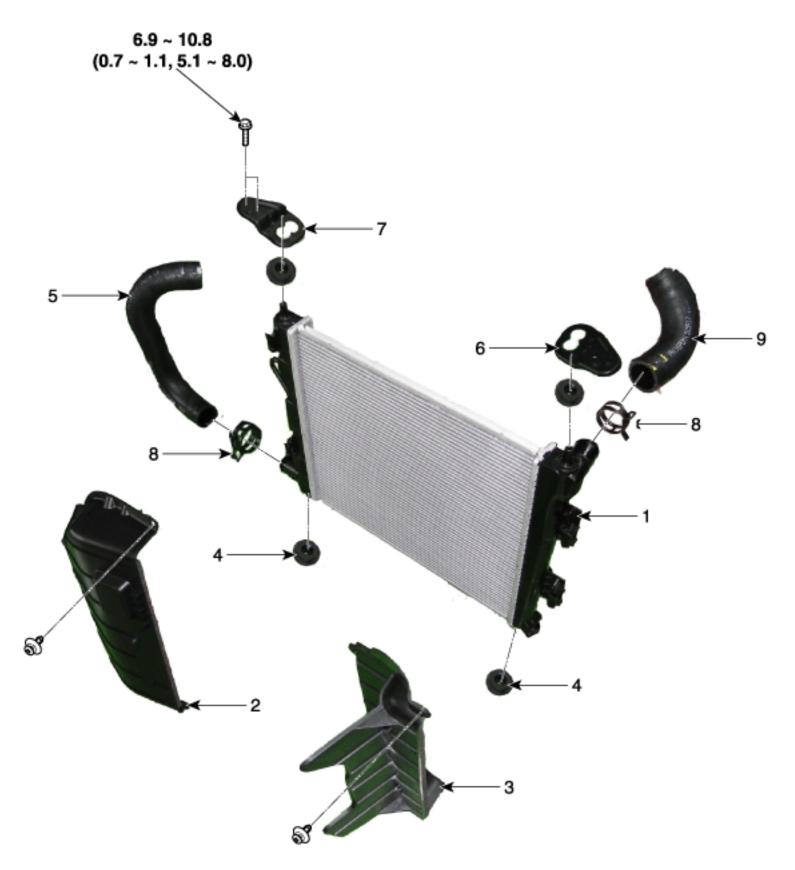
# NOTICE

Using the SST (09221-4A000), tighten the bolts which need to be tightened with the angular tightening method.



- Do not reuse the connecting rod cap bolts.
- Maintain downward force on the ring compressor to prevent the rings from expending before entering the cylinder bore.
- 5. Check the connecting rod end play.
- 6. Assemble the other parts in the reverse order of disassembly.

# **COMPONENTS**



# Torque: N.m (kgf.m, lb-ft)

- 1. Radiator
- 2. Radiator air guard (LH)
- 3. Radiator air guard (RH)
- 4. Mounting insulator
- 5. Radiator lower hose

- 6. Radiator upper mounting bracket (RH)
- 7. Radiator upper mounting bracket (LH)
- 8. Clamp
- 9. Radiator upper hose

# **REMOVAL AND INSTALLATION**

# **▲** WARNING

Never remove the radiator cap when the engine is hot. Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

- 1. Remove the cooling fan. (Refer to Cooling System - "Cooling Fan")
- 2. Drain the coolant. (Refer to Cooling System - "Coolant")
- 3. Remove the front bumper. (Refer to Body - "Front Bumper")
- 4. Remove the radiator upper hose (A) and the lower hose (B).





5. Remove the radiator upper cover (A).



6. Disconnect the air guard (A) and upper cover (B).



7. Remove the radiator upper mounting bracket (A).

# Tightening torque:

6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)



# NOTICE

Remove the radiator cap to speed draining.

8. Separate the condenser (A) from the radiator and then remove the radiator assembly (B).



- 9. Install in the reverse order of removal.
- 10. Fill the radiator with coolant and check for leaks.

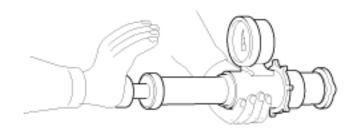
# NOTICE

- · Bleed air from the cooling system.
- Start engine and let it run until it warms up. (Until the radiator fan operates 3 or 4 times.)
- Turn off engine. Check the coolant level and add coolant if needed. This will allow trapped air to be removed from the cooling system.
- Put the radiator cap on tightly, then run engine again and check for leaks.

# **INSPECTION**

# Radiator Cap Testing

1. Remove the radiator cap, wet its seal with engine coolant, and then install it on a pressure tester.



- 2. Apply a pressure of 93.16~122.58kPa (0.95~1.25kgf/cm², 13.51~17.78psi).
- 3. Check for a drop in pressure.
- 4. If the pressure drops, replace the cap.

# Radiator Leakage Test

- 1. Wait until engine is cool, then carefully remove the radiator cap and fill the radiator with engine coolant, then install it on the pressure tester.
- 2. Apply a pressure tester to the radiator and apply a pressure of 93.16~122.58kPa (0.95~1.25kgf/cm², 13.51~17.78psi).



- 3. Inspect for engine coolant leaks and a drop in pressure.
- 4. Remove the tester and reinstall the radiator cap.

# NOTICE

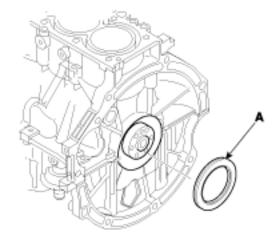
Check for engine oil in the coolant and/or coolant in the engine oil.

# **REMOVAL**

Remove the automatic Transaxle.
 (Refer to Manual Transaxle System - "Automatic Transaxle")
 Remove the manual transaxle.
 (Refer to Manual Transaxle System - "Manual Transaxle")

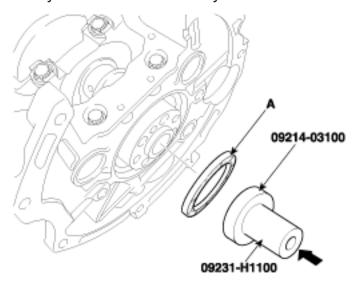
 Automatic transaxle : Remove the drive plate. (Refer to Cylinder Block - "Drive Plate") Manual transaxle : Remove the flywheel. (Refer to Cylinder Block - "Flywheel")

3. Remove the rear oil seal (A).



# **INSTALLATION**

- 1. 1. Install a new rear oil seal.
  - (1) Apply engine oil on the edge of new oil seal.
  - (2) Using SST (09231-H1100, 09214-03100) and a hammer, tap in the oil seal (A) until the SST face is aligned with the cylinder block assembly rear face.



2. Install the other parts reverse order of removal.

# **SPECIAL SERVICE TOOLS**

SI ESIAL SERVICE 188ES				
Tool (Number and name)	Illustration	Use		
Flywheel stopper (09231-2B100) (09231-3N100)	09231-3N100 09231-2B100	Removal and installation of the flywheel and crankshaft pulley		
Torque angle adapter (09221-4A000)	The same of the sa	Installation of bolts & nuts needing an angular method		
Valve stem seal installer (09222-03100)		Installation of the valve stem seal		
Valve spring compressor & holder (09222-3K000) (09222-3K100)	A B	Removal and installation of the intake or exhaust valves A: 09222-3K000 B: 09222-3K100 (holder)		
Crankshaft front oil seal installer (09214-1R000) (09231-1H100)		Installation of the crankshaft front oil seal		
Crankshaft rear oil seal installer (09214-03100) (09231-H1100)	09231-H1100 09214-03100	Installation of the crankshaft rear oil seal		

# Oil pan remover (09215-3C000)

Removal of oil pan

Oil filter wrench (09263-02000)	Removal and installation of oil filter
Drive belt remove & installer (09252-03100)	Remove and installation of the full option type drive belt. Remove of the non-A/C type drive belt.
Drive belt remove & installer (Non-A/C type) (09252-03200)	Installation of the non-A/C type drive belt.

# **SPECIFICATIONS**

**Description** 

General				
Туре		In-line, DOHC		
Number of cylinders		4	1	
Bore		71.0 mm (	2.7953 in)	
Stroke		75.6 mm (2.9763 in)	78.8 mm (3.1023 in)	
Total displacement		1.197 cc (72.7 cu.in)	1.248 cc (76.2 cu.in)	
Compression ratio		10.5	5 : 1	
Firing order		1-3-	-4-2	
Valve timing				
Intake valve	Opens	ATDC 10°		
Intake valve	Closes	ABDC 66.6°		
Exhaust valve	Opens	BBDC 44.4°	BBDC 52.4°	
Exhaust valve	Closes	ATDC 3°	ATDC 3°	
Cylinder head				
Flatness of gasket surface		Less than 0.05 Less than 0.02 mm (0	mm (0.0025 in) 0.0008 in) / 100 x 100	
Flatness of manifold	Intake	Less than 0.1 mm (0.0039 in)		
mounting surface	Exhaust	Less than 0.1 mm (0.0039 in)		

1.20

# Camheight

Camshaft

Exhaust	
Intake/Exhaust No.1	

Intake

36.4183 mm (1.4337 in) 35.7330 mm (1.4068 in) 36.1543 mm (1.4233 in)

Valve

Intake/Exhaust No.2~5 Intake

36.464 ~ 36.478 mm (1.4355 ~ 1.4361 in)

22.964 ~ 22.978 mm (0.9040 ~ 0.9046 in)

100.94 mm (3.9740 in)

**Specification** 

1.25

Valve length

Journal outer Diameter

Exhaust Intake

101.09 mm (3.9799 in) 5.465 ~ 5.480 mm (0.2151 ~ 0.2157 in)

5.448 ~ 5.460 mm (0.2144 ~ 0.2149 in)

Stem outer diameter Face angle

Thickness of valve

Exhaust

Intake

Exhaust

Exhaust

Intake

45.25° ~ 45.75°

1.50 mm (0.0590 in) 1.75 mm (0.0688 in)

47.9 mm (1.8858 in)

 $0.020 \sim 0.047 \text{ mm} (0.00078 \sim 0.00185 \text{ in})$  $0.040 \sim 0.064 \text{ mm} (0.00157 \sim 0.00251 \text{ in})$ 



Limit

Valve spring Free length

Valve stem to valve

guide clearance

head (margin)

Load		16.7 ± 0.8 kg / 35.5 mm (164 ± 8 N / 1.3976 in)	
		29.6 ± 1.0 kg /27.7 mm (290 ± 10 N / 1.0905 in)	
Out of squareness		1.5° MAX	
Cylinder block			
Cylinder bore		71.00 ~ 71.03 mm (2.7952 ~ 2.7964 in)	
Flatness of gasket surface		Less than 0.05 mm (0.0020 in) Less than 0.02 mm (0.0008 in) / 100 x 100	
Piston			
Piston outer diameter		70.97 ~ 71.00 mm (2.7952 ~ 2.7940 in)	
Piston to cylinder clearance		0.02 ~ 0.04 mm (0.0008 ~ 0.0016 in)	
Ring groove width	No. 1 ring groove	1.035 ~ 1.05 mm (0.0407 ~ 0.0413 in)	
	No. 2 ring groove	1.23 ~ 1.25 mm (0.0484 ~ 0.0492 in)	
	Oil ring groove	2.010 ~ 2.025 mm (0.0791 ~ 0.0797 in)	
Piston ring			
Side clearance	No. 1 ring	0.05 ~ 0.08 mm (0.0019 ~ 0.0031 in)	
	No. 2 ring	0.04 ~ 0.08 mm (0.0015 ~ 0.0031 in)	
	Oil ring	0.040 ~ 0.115 mm (0.0015 ~ 0.0045 in)	
End gap	No. 1 ring	0.13 ~ 0.25 mm (0.0051 ~ 0.0098 in)	
	No. 2 ring	0.30 ~ 0.45 mm (0.0118 ~ 0.0177 in)	
	Oil ring	0.1 ~ 0.4 mm (0.0039 ~ 0.0157 in)	
Piston pin			
Piston pin outer diameter		18.000 ~ 18.003 mm (0.7086 ~ 0.7087 in)	
Piston pin hole inner diameter		18.013 ~ 18.017 mm (0.7092 ~ 0.7093 in)	
Piston pin hole clearance		0.010 ~ 0.017 mm (0.00039 ~ 0.00067 in)	
Connecting rod small end hole inner diameter		17.974 ~ 17.985 mm (0.7076 ~ 0.7474 in)	
Connecting rod small end hole clearance		0.015 ~ 0.029 mm (0.00059 ~ 0.00114 in)	
Piston pin press-in load		250 ~ 1050 kg (551 ~ 2314 lb)	
Connecting rod			
Connecting rod big end inner diameter		42.000 ~ 42.018 mm (1.6535~1.6542 in)	
Connecting rod bearing oil clearance		0.018 ~ 0.036 mm (0.0007 ~ 0.0014 in)	
Side clearance		0.1 ~ 0.25 mm (0.0039 ~ 0.0098 in)	
Crankshaft			
Main journal outer diameter		42.942 ~ 42.960 mm (1.6906~1.6913 in)	
Pin journal outer diameter		38.954 ~ 38.972 mm (1.5336~1.5343 in)	
Main bearing oil clearance		0.006 ~ 0.024 mm (0.0002~0.0009 in)	
End play		0.05 ~ 0.25 mm (0.0019~0.0098 in)	
Oil pump			
Side clearance	Inner rotor	0.040 ~ 0.090 mm (0.0016 ~ 0.0035 in)	
	Outer rotor	0.040 ~ 0.090 mm (0.0016 ~ 0.0035 in)	
Relief spring	Free length	58.3 mm (2.2952 in)	
	Load	3.5bar ± 0.5	

Engine oil			
	Total	3.55 L (0.93 U.S.gal., 3.75 U.S.qt., 3.12 lmp.qt.)	When replacing a short engine or a block assembly
Oil quantity	Oil pan	3.3 L (0.87 U.S.gal., 3.48 U.S.qt., 2.90 lmp.qt.)	
On quantity	Drain and refill	Except India: 3.5 L (0.92 U.S.gal., 3.70 U.S.qt., 3.08 Imp.qt) For India: 3.6 L (0.10 U.S.gal., 3.80 U.S.qt., 3.17 Imp.qt.)	Including oil filter
	Recommendation	For all except Middle East and India ILSAC GF-4, API SM or above / 5W-20 ACEA A5, API SM or above / 5W-30  For Middle East and India	
Oil grade	Allowed	ACEA A5, API SM or above / 5W-30  API SL, SM or above ILSAC GF-3, GF4 or above ACEA A3, A5 or above For information on SAE viscosity grades based on ambient temperatures, refer to the "Lubrication System".	Usable if the recommended engine oil is not available
	Approved	SK (ZIC LD 5W-30), Chevron (KIXX G1 LL), Total (QUARTZ HKS G-310, QUARTZ INEO MC3 5W-30), Shell (HELIX ULTRA AH-E 5W-30, HELIX ULTRA 5W-40), Fuchs (TITAN SUPERSYN LONG LIFE 5W-30/40)	List of engine oil approved by HYUNDAI
Oil pressure (at 1000rpr	m)	0.9 bar or above	Oil temperature in oil pan : 110 ± 2°C (230 ± 3.6°F)
Cooling method			
Cooling system		Forced circulation with water pump	
Coolant quantity		MT : Approx. 5.3 L (1.39 U.S.gal., 5.60 U.S.qt., 4.66 lmp.qt.) AT : Approx. 5.2 L (1.37 U.S.gal., 5.49 U.S.qt., 4.57 lmp.qt.)	
	Type	Wax pellet type	
Thermostat	Opening temperature	88 ± 1.5°C (190.4 ± 2.7°F)	
	Full opening temperature	100°C (212°F)	
Padiator con	Main valve opening pressure	93.16 ~ 122.58 kpa (0.95 ~ 1.25 kg/cm², 13.51 ~ 17.78 psi)	
Radiator cap	Vacuum valve opening pressure	0.98 ~ 4.90 kPa (0.01 ~ 0.05 kg/cm², 0.14 ~ 0.71 psi)	
Water temperature ser	nsor		
Туре		Thermistor type	
Resistance	20°C (68°F)	2.45 ± 0.14 kΩ	
1 Coloral ICC	80°C (176°F)	0.3222 kΩ	

### Tightening Torques

Engine mounting insulator to engine mounting

Engine mounting support bracket and engine

Engine mounting support bracket and engine

Transaxle mounting bracket and body fixing bolt

Transaxle mounting bracket and body fixing nut

Transaxle mounting support bracket to transaxle

Roll rod bracket and sub frame fixing bolt

Roll rod bracket and roll rod mounting support

support bracket fixing nut

support bracket fixing bolt

support bracket fixing nut

mounting fixing bolt

bracket bolt

Cylinder block

Ladder frame bolt

Main moving system

Fly wheel bolt (M/T)

Timing chain cover bolt (A)

Timing chain cover bolt (B)

Timing chain cover bolt (C)

Timing chain cover bolt (D)

Timing chain tensioner bolt

Timing chain cam guide bolt

Timing chain crank guide bolt

Timing chain guide bolt

Cylinder head cover bolt

Camshaft bearing cap bolt

Cylinder head

Timing chain tensioner arm bolt

Crankshaft pulley bolt

CVVT bolt

Timing chain

Connecting rod bearing cap bolt

Crankshaft main bearing cap bolt

iteiii	
Engine mounting	
Engine mounting bracket and body fixing blot	
Engine mounting bracket and body fixing nut	

N.m

 $49.0 \sim 63.7$ 

49.0 ~ 63.7

 $63.7 \sim 83.3$ 

58.8 ~ 73.5

58.8 ~ 73.5

 $49.0 \sim 63.7$ 

 $49.0 \sim 63.7$ 

88.3 ~ 107.9

49.0 ~ 63.7

 $107.9 \sim 12.75$ 

19.6 ~ 23.5

[10.8 ~ 14.7] + [88 ~

92°]

[17.7 ~ 21.6] + [88 ~

92°]

68.6 ~ 78.5

 $18.6 \sim 23.5$ 

44.1 ~ 53.9

 $9.8 \sim 11.8$ 

 $18.6 \sim 23.5$ 

[55.9 ~ 61.8] + [38 ~

42°]

 $63.7 \sim 73.5$ 

9.8 ~ 11.8

9.8 ~ 11.8

9.8 ~ 11.8

9.8 ~ 11.8

18.6 ~ 21.6

 $[3.9 \sim 5.9] \rightarrow$ 

 $[7.8 \sim 9.8]$ 

 $[5.9] \rightarrow [11.8 \sim 13.7]$ 

kgf.m

 $5.0 \sim 6.5$ 

 $5.0 \sim 6.5$ 

 $6.5 \sim 8.5$ 

 $6.0 \sim 7.5$ 

 $6.0 \sim 7.5$ 

 $5.0 \sim 6.5$ 

 $5.0 \sim 6.5$ 

 $9.0 \sim 11.0$ 

 $5.0 \sim 6.5$ 

11.0 ~ 13.0

 $2.0 \sim 2.4$ 

[1.1 ~ 1.5] + [88 ~

92°]

[1.8 ~ 2.2] + [88 ~

92°]

 $7.0 \sim 8.0$ 

 $1.9 \sim 2.4$ 

 $4.5 \sim 5.5$ 

 $1.0 \sim 1.2$ 

 $1.9 \sim 2.4$ 

[5.7 ~ 6.3] + [38 ~

42°]

 $6.5 \sim 7.5$ 

1.0 ~ 1.2

 $1.0 \sim 1.2$ 

 $1.0 \sim 1.2$ 

1.0 ~ 1.2

 $1.9 \sim 2.2$ 

 $[0.4 \sim 0.6] \rightarrow$ 

 $[0.8 \sim 1.0]$ 

 $[0.6] \rightarrow [1.2 \sim 1.4]$ 

lb-ft

 $36.1 \sim 47.0$ 

36.1 ~ 47.0

46.9 ~ 61.4

43.3 ~ 54.2

43.3 ~ 54.2

 $36.1 \sim 47.0$ 

 $36.1 \sim 47.0$ 

65.1 ~ 79.6

 $36.1 \sim 47.0$ 

79.6 ~ 94.0

14.5 ~ 17.4

[8.0 ~ 10.8] + [88 ~

92°]

[13.0 ~ 15.9] + [88 ~

92°1

50.6 ~ 57.9

 $13.7 \sim 17.4$ 

 $32.5 \sim 39.8$ 

 $7.2 \sim 8.7$ 

 $13.7 \sim 17.4$ 

[41.2 ~ 45.5] + [38 ~

42°]

47.0 ~ 54.2

 $7.2 \sim 8.7$ 

 $7.2 \sim 8.7$ 

 $7.2 \sim 8.7$ 

 $7.2 \sim 8.7$ 

 $13.7 \sim 15.9$ 

 $[2.9 \sim 4.3] \rightarrow$ 

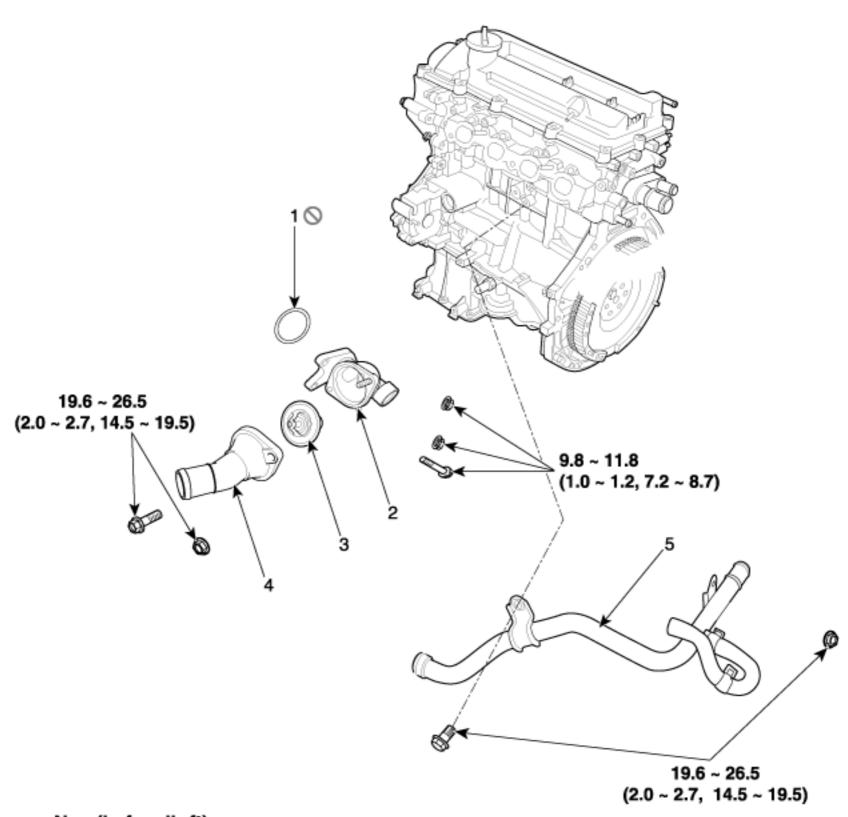
 $[5.8 \sim 7.2]$ 

 $[4.3] \rightarrow [8.7 \sim 10.1]$ 

Camshaft front bearing cap bolt	$[9.8] \rightarrow [18.6 \sim 22.6]$	$[1.0] \rightarrow [1.9 \sim 2.3]$	$[7.2] \rightarrow [13.7 \sim 16.6]$
Cylinder head bolt	[12.7 ~ 16.7] + [90 ~ 95°] + [120 ~ 125°]	[1.3 ~ 1.7] + [90 ~ 95°] + [120 ~ 125°]	[9.4 ~ 12.3] + [90 ~ 95°] + [120 ~ 125°]
OCV bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cooling system			
Water pump pulley bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Heater pipe bolt & nut	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Thermostat housing bolt & nut	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water inlet fitting bolt & nut	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Lubrication system			
Oil filter	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6
Oil pump	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan drain plug	34.3 ~ 44.1	3.5 ~ 4.5	25.2 ~ 32.4
Oil screen bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pressure switch	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Intake and exhaust system			
Intake manifold bolt & nut	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Exhaust manifold stay	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Exhaust manifold heat protector	8.8 ~ 10.8	0.9 ~ 1.1	6.5 ~ 7.9
Throttle body fixing self screw	6.4 ~ 8.3	0.65 ~ 0.85	4.7 ~ 6.1
Exhaust manifold nut	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Exhaust manifold and front muffler mounting nut	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Front muffler and center muffler mounting nut	39.2 ~ 53.9	4.0 ~ 5.5	28.9 ~ 39.8
Center muffler and main muffler clamp mounting nut	17.7 ~ 27.5	1.8 ~ 2.8	13.0 ~ 20.3

# System > Thermostat

### **COMPONENTS**



Torque : N.m (kgf.m, lb-ft)

1	. (	)-	rı	n	g
---	-----	----	----	---	---

- 2. Thermostat housing
- 3. Thermostat

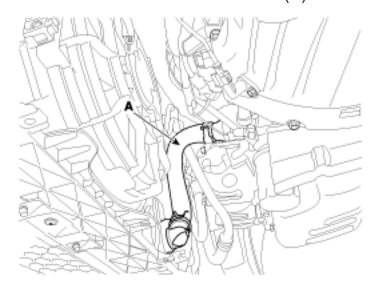
- 4. Water inlet fitting
- 5. Heater pipe

#### **REMOVAL AND INSTALLATION**

### NOTICE

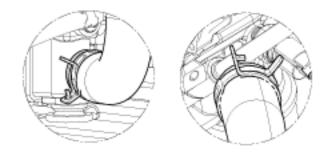
Disassembly of the thermostat would have an adverse effect, causing a lowering of cooling efficiency.

- 1. Drain the engine coolant so its level is below thermostat.
- 2. Disconnect the radiator lower hose (A).



### NOTICE

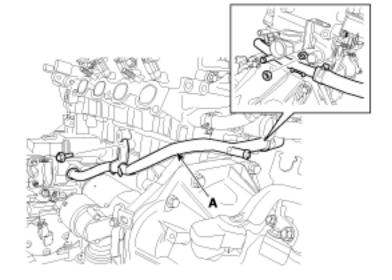
Install the radiator hose as showm illustrations.



- 3. Disconnect the heater hoses.
- 4. Remove the intake manifold. (Refer to Intake and exhaust system in this group)
- 5. Disconnect the water hose and then remove the heater pipe (A).

### Tightening torque:

19.6 ~ 26.5 N.m (2.0 ~ 2.7 kgf.m, 14.5 ~ 19.5 lb-ft)



6. Remove the water temperature control assembly (A).

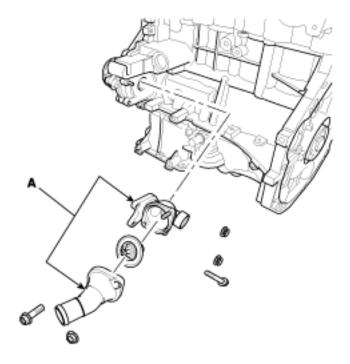
#### **Tightening torque**

Thermostat housing bolt & nut:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

Water inlet fitting bolt & nut:

19.6 ~ 26.5 N.m (2.0 ~ 2.7 kgf.m, 14.5 ~ 19.5 lb-ft)



- 7. Install in the reverse order of removal.
- 8. Fill with engine coolant.
- 9. Start the engine and check for leaks.
- 10. Recheck the engine coolant level.

### **INSPECTION**

1. Immerse the thermostat in water and gradually heat the water.



2. Check the valve opening temperature.

Valve opening temperature : 88 ± 1.5°C (190.4 ± 2.7°F)

Full opening temperature : 100°C (212°F)

3. Check the valve lift.

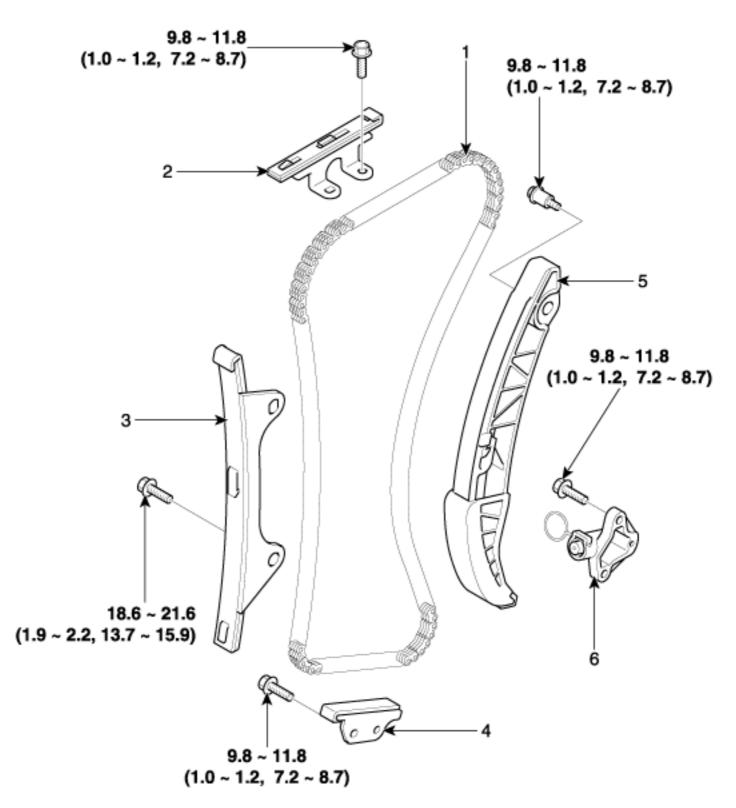
Valve lift: 8 mm (0.3 in) or more at 95°C (203°F)

### TROUBLESHOOTING

TROUBLESHOOTING					
Sym	ptoms	Poss	ible Causes	Remedy	
Coolant leakage	From the thermostat	Check the mounting bolts	Check the torque of the mounting bolts	Retighten the bolts and check leakage again.	
	gasket	Check the gasket for damage	Check gasket or seal for damage	<ul> <li>Replace gaskets and reuse the thermostat.</li> </ul>	
Cooled excessively	<ul> <li>Low heater performance (cool air</li> </ul>	Visually check after removing the radiator cap.	Insufficient coolant or leakage.	After refilling coolant, recheck.	
	blowed-out)  • Thermogauge indicates 'LOW'	GDS check&Starting engine	<ul> <li>Check DTCs</li> <li>Check connection of the fan clutch or the fan motor.</li> <li>If the fan clutch is always connected, there will be a noise at idle.</li> </ul>	<ul> <li>Check the engine coolant sensor, wiring and connectors.</li> <li>Replace the componants.</li> </ul>	
		Remove the thermostat and inspect	Check if there are dusts or chips in the thermostat valve.	Clean the thermostat valve and reuse the thermostat.	
			Check adherence of the thermostat.	<ul> <li>Replace the thermostat, if it doesn't work properly.</li> </ul>	
excessively	<ul> <li>Engine overheated</li> <li>Thermogauge indicates 'HI'</li> </ul>	Visually check after removing the radiator cap.	<ul> <li>Insufficient coolant or leakage.</li> <li>* Be careful when removing a radiator cap of the overheated vehicle.</li> <li>Check air in cooling system.</li> </ul>	<ul> <li>After refilling coolant, recheck.</li> <li>Check the cylinder head gaskets for damage and the tightening torque of the mounting bolts.</li> </ul>	
		GDS check&Starting engine	<ul> <li>Check DTCs</li> <li>Check the fan motor performance as temperature varies.</li> <li>Check if the fan clutch slips.</li> <li>Check the water pump adherence or impeller damaged.</li> </ul>	<ul> <li>Check the engine coolant sensor, wiring and connectors.</li> <li>Check the fan motor, the relay and the connector.</li> <li>Replace the fan clutch, if it doesn't work properly.</li> <li>Replace the water pump, if it doesn't work properly.</li> </ul>	

	Immerse the thermostat in boiling water and inspection.	<ul> <li>After removing the thermostat, check it works properly.</li> <li>* Check the thermostat opens at the valve opening temperature.</li> </ul>	<ul> <li>Replace the thermostat, if it doesn't work properly.</li> </ul>
<u> </u>			

### **COMPONENTS**



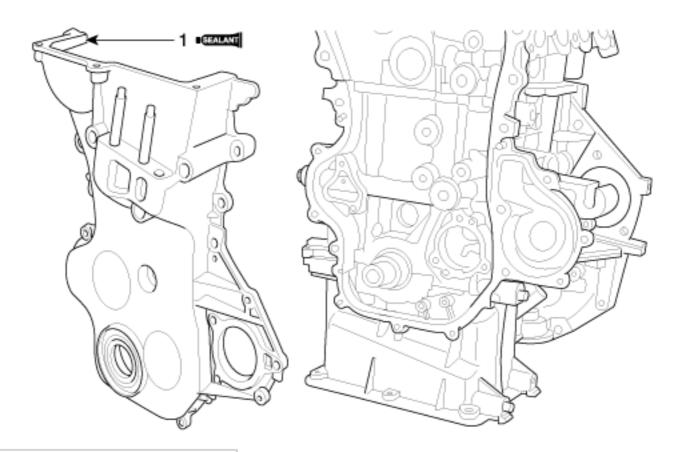
Torque: N.m (kgf.m, lb-ft)

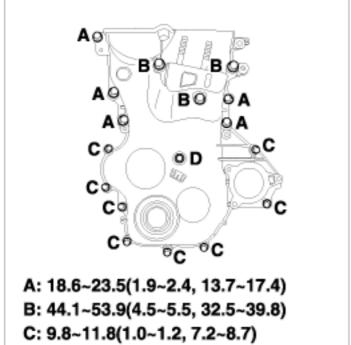
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- 2. Timing chain cam guide
- 3. Timing chain guide

- 4. Timing chain crank guide
- 5. Timing chain tensioner arm
- 6. Timing chain tensioner

### **COMPONENTS**





D: 18.6~23.5(1.9~2.4, 13.7~17.4)

Torque: N.m (kgf.m, lb-ft)

1. Timing chain cover

#### **REMOVAL**

Engine removal is not required for this procedure.

### **▲** CAUTION

- · Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

#### NOTICE

Mark all wiring and hoses to avoid misconnection.

- Remove the air cleaner assembly. (Intake and Exhaust System - "Air Cleaner")
- 2. Remove the engine room under cover.
- Remove the drive belt.(Refer to Timing System "Drive Belt")
- Remove the alternator.
   (Refer to Engine Electrical System "Alternator")
- Remove the crankshaft damper pulley. (Refer to Timing System - Crankshaft Damper Pulley")
- Remove the water pump.(Refer to Cooling System "Water Pump")
- 7. Remove the cylinder head cover. (Refer to Cylinder Head Assembly "Cylinder Head Cover")
- 8. Remove the engine mounting support bracket. (Refer to Engine and Transmission Assembly "Engine Mounting")

#### NOTICE

- Set a jack to support the engine before the mounting bracket is removed.
- Place a rubber block between the jack and oil pan.
- 9. Remove the timing chain cover (A).



#### NOTICE

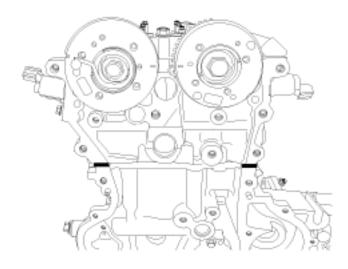
Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover.

#### **INSTALLATION**

- 1. 1. Install the timing chain cover (A).
  - (1) The sealant locations on chain cover and on counter parts (cylinder head, cylinder block) must be free of engine oil and etc.
  - (2) Before assembling the timing chain cover, the liquid sealant MS721-40AA should be applied on the gap between cylinder head and cylinder block.

The part must be assembled within 5 minutes after sealant was applied.

Bead width: 4.0 mm (0.16 in.)



(3) Before assembling the timing chain cover, The liquid sealant MS721-40AA should be applied on chamfer of timing chain cover. Equivalent to TB1282B or equivalent to TB1216E for groove of water pump. The part must be assembled within 5 minutes after the sealant was applied.

Sealant should be applied in a continuous bead in each of the areas indicated below.

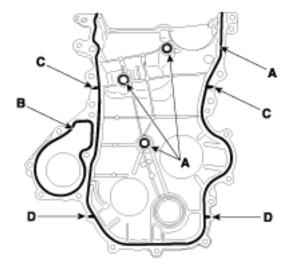
#### **Bead width**

A:  $2.5 \sim 3.5 \text{ mm} (0.09 \sim 0.14 \text{ in.})$ 

B: 1.5 ~ 2.5 mm (0.06 ~ 0.10 in.)

C:  $4.5 \sim 5.5 \text{ mm} (0.18 \sim 0.22 \text{ in.})$ 

D:  $3.5 \sim 4.5 \text{ mm} (0.14 \sim 0.18 \text{ in.})$ 



### NOTICE

During timing cover installation, care not to take off applied sealant on the timing cover by contact with other parts.

(4) The dowel pins on the cylinder block and holes on the timing chain cover should be used as a reference in order to assemble the timing chain cover correctly.

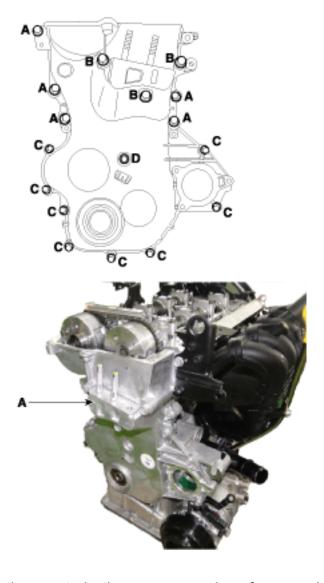
#### **Tightening torque**

A: 18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft) -5EA

B : 44.1  $\sim$  53.9 N.m (4.5  $\sim$  5.5 kgf.m, 32.5  $\sim$  39.8 lb-ft) -3EA

C: 9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft) -8EA

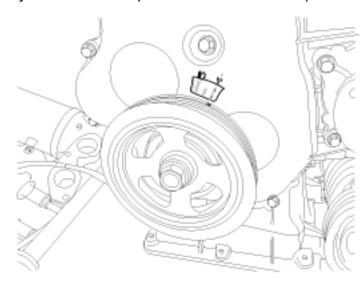
D: 18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft) -1EA



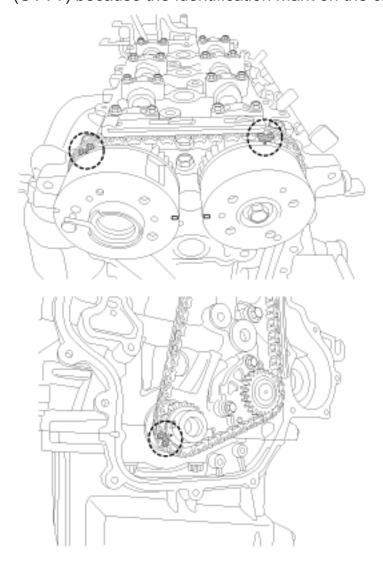
2. Install the other parts in the reverse order of removal.

#### **REMOVAL**

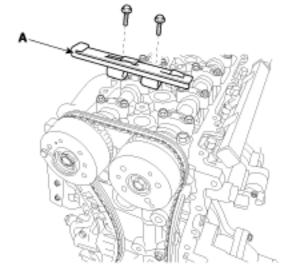
- Remove the cylinder head cover.
   (Refer to Cylinder Head Assembly "Cylinder Head Cover")
- 2. Turn the crankshaft pulley and align its groove with the timing mark of the timing chain cover to set the piston of No.1 cylinder to the top dead center on compression stroke.



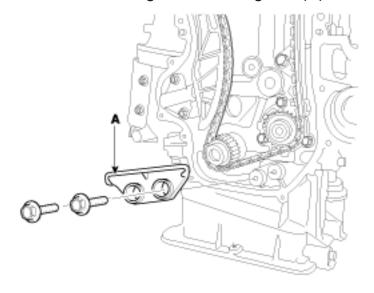
- Remove the timing chain cover.
   (Refer to Timing System "Timing Chain Cover")
- 4. Before removing the timing chain, mark the timing chain with an identification based on the location of the sprocket (CVVT) because the identification mark on the chain for TDC (Top Dead Center) can be erased.



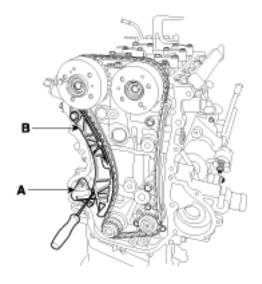
5. Remove the timing chain cam guide (A).



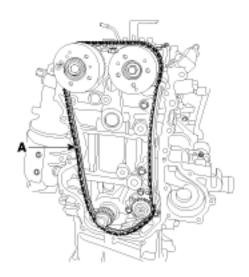
6. Remove the timing chain crank guide (A).



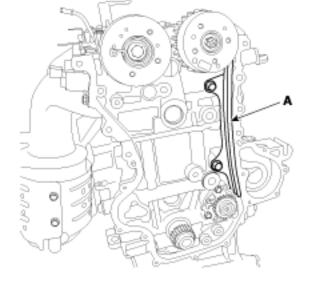
7. Install a set pin after compressing the timing chain tensioner by push the timing chain tensioner arm arrow direction. and then remove the tensioner (A) and the tensioner arm (B).



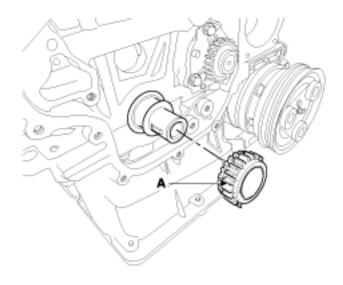
8. Remove the timing chain (A).



9. Remove the timing chain guide (A).



10. Remove the crankshaft sprocket (A).



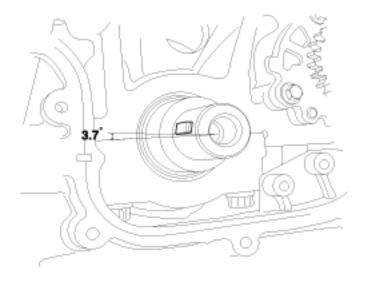
#### **INSPECTION**

### Sprockets, Chain Tensioner, Chain Guide, Chain Tensioner Arm

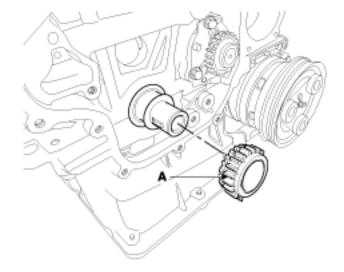
- 1. Check the camshaft sprocket and crankshaft sprocket for abnormal wear, cracks, or damage. Replace as necessary.
- 2. Inspect the tensioner arm and chain guide for abnormal wear, cracks, or damage. Replace as necessary.
- 3. Check that the tensioner piston moves smoothly.

#### **INSTALLATION**

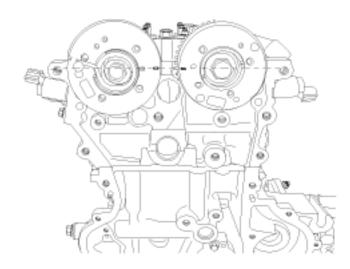
1. Set the key (A) of crankshaft about 3.7° with horizontal center line. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.



2. Install the crankshaft sprocket (A).



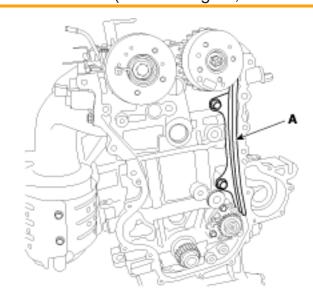
3. Align the mark of cam shaft sprocket (CVVT) on the top surface of cylinder head. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.



4. Install the timing chain guide (A).

#### **Tightening torque:**

18.6 ~ 21.6 N.m (1.9 ~ 2.2 kgf.m, 13.7 ~ 15.9 lb-ft)



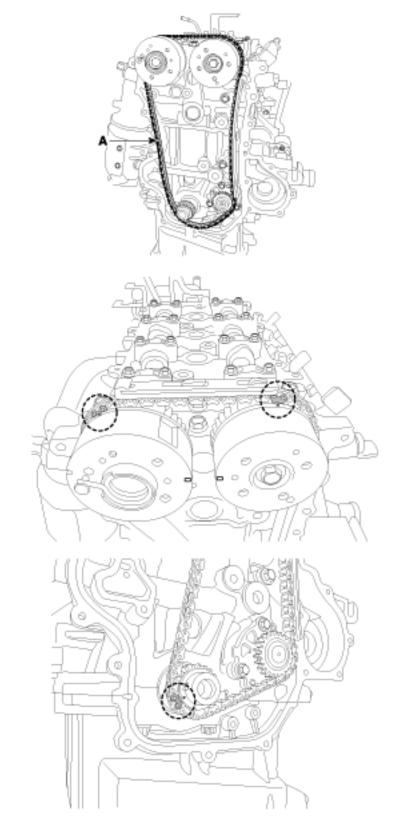
5. Install the timing chain (A).

### NOTICE

Install the timing chain with no slack and recommend the below procedure.

Crankshaft sprocket  $\rightarrow$  Oil pump sprocket  $\rightarrow$  Timing chain guide  $\rightarrow$  Intake camshaft sprocket (CVVT)  $\rightarrow$  Exhaust camshaft sprocket (CVVT).

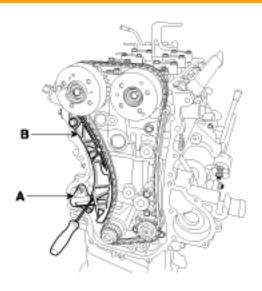
The timing mark of each sprocket should be matched with timing mark (color link) of timing chain at during installation.



6. Install the timing chain tensioner arm (B) and the timing chain tensioner (A) and then remove the stopper pin.

### Tightening torque:

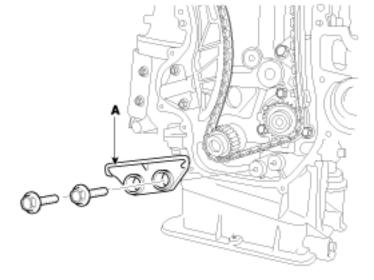
 $9.8 \sim 11.8 \text{ N.m} (1.0 \sim 1.2 \text{ kgf.m}, 7.2 \sim 8.7 \text{ lb-ft})$ 



7. Install the timing chain crank guide (A).

### Tightening torque:

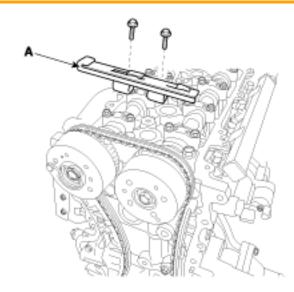
 $9.8 \sim 11.8 \text{ N.m} (1.0 \sim 1.2 \text{ kgf.m}, 7.2 \sim 8.7 \text{ lb-ft})$ 



8. Install the timing chain cam guide (A).

#### Tightening torque:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



9. After rotating the crankshaft 2 revolutions in regular direction (clockwise viewed from front), confirm the timing

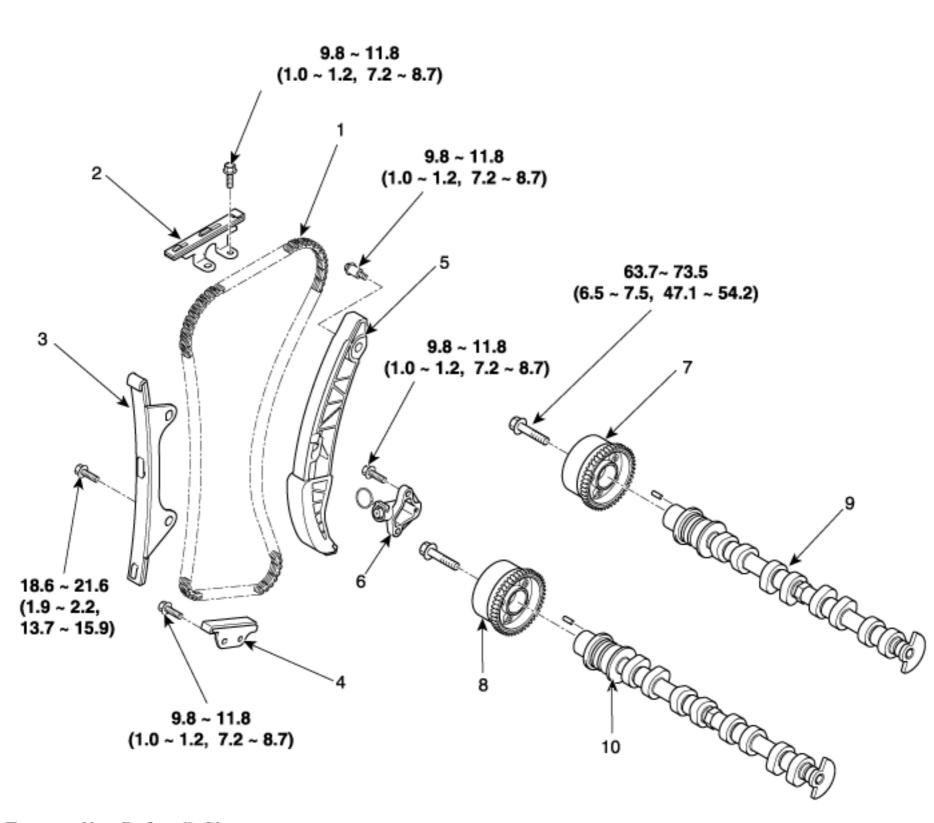
### NOTICE

Always turn the crankshaft clockwise.

Turning the crankshaft counter clockwise before building up oil pressure in the hydraulic timing chain tensioner may result in the chain disengaging from the sprocket teeth.

10. Install the other parts in the reverse order of removal.

### **COMPONENTS**



### Torque : N.m (kgf.m, lb-ft)

- 1. Timing chain
- 2. Timing chain cam guide
- 3. Timing chain guide
- 4. Timing chain crank guide
- 5. Timing chain tensioner arm
- 6. Timing chain tensioner
- 7. Exhaust CVVT

- 8. Intake CVVT
- 9. Exhaust camshaft
- 10. Intake camshaft

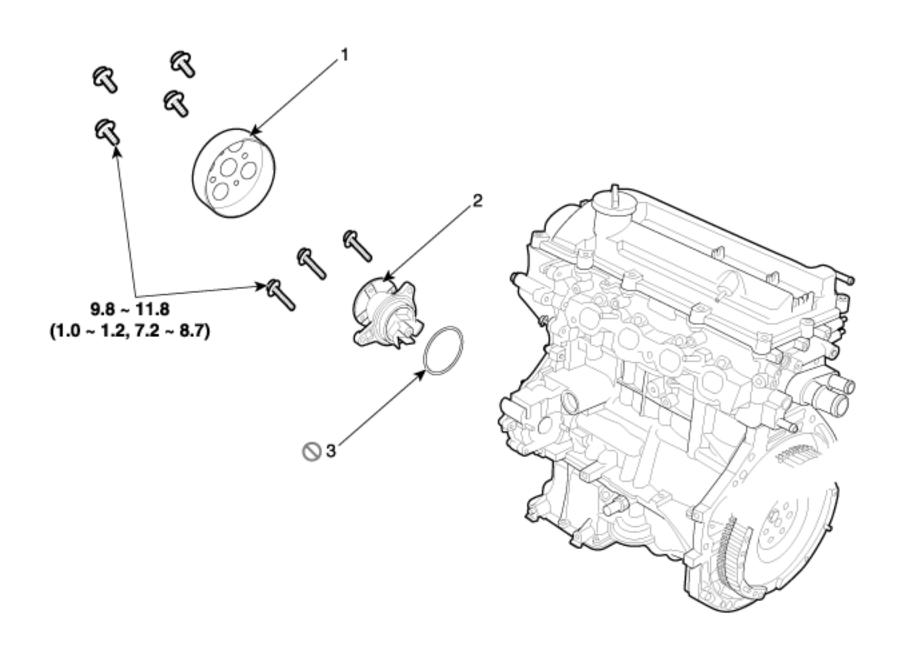
## **TROUBLESHOOTING**

Suspect area	Remedy
Worn crankshaft bearings. Loose or damaged engine drive plate.	Replace the crankshaft and bearings as required. Repair or replace the drive plate as required.
Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression.Repair or replace as required.
Worn crankshaft thrust bearings	Replace the crankshaft and bearings as required.
Stuck valves. (Carbon buildup on the valve stem)	Repair or replace as required.
Excessive worn or mis-aligned timing chain.	Replace the timing chain and sprocket as required.
Worn camshaft lobes.	Replace the camshaft and valve lifters.
HLA sponge	Run the engine at 2500~3000rpm within 15 minutes. If it dosen't disappear, refer to cylinder head assembly in this group.
Faulty cylinder head gasket and/or cranking or other damage to the cylinder head and engine block cooling system.	<ul> <li>Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket.</li> </ul>
<ul> <li>Coolant consumption may or may not cause the engine to overheat.</li> </ul>	<ul> <li>Repair or replace as required.</li> </ul>
Worn valves, guides and/or valve stem oil seals.	Repair or replace as required.
Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	<ul> <li>Inspect the cylinder for a loss of compression.</li> <li>Repair or replace as required.</li> </ul>
Incorrect oil viscosity.	Drain the oil.      Install the correct viscosity oil.
Worn crankshaft thrust bearing.	Inspect the thrust bearing and crankshaft.
	Repair or replace as required.
Low oil pressure.	Repair or replace as required.
Broken valve spring.	Replace the valve spring.
Worn or dirty valve lifters.	Replace the valve lifters.
Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn crankshaft bearings. Loose or damaged engine drive plate.  Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)  Worn crankshaft thrust bearings  Stuck valves. (Carbon buildup on the valve stem)  Excessive worn or mis-aligned timing chain.  Worn camshaft lobes.  HLA sponge  • Faulty cylinder head gasket and/or cranking or other damage to the cylinder head and engine block cooling system.  • Coolant consumption may or may not cause the engine to overheat.  Worn valves, guides and/or valve stem oil seals.  Worn piston rings. (Oil consumption may or may not cause the engine to misfire)  Incorrect oil viscosity.  Worn crankshaft thrust bearing.  Low oil pressure.  Broken valve spring.  Worn or dirty valve lifters.  Stretched or broken timing chain

	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	Inspect the camshaft lobes.
		Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves.Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the valves and valve guides, then repair as required.
	Worn drive belt, idler, tensioner and bearing.	Replace as required.
Lower engine noise, regardless of	Low oil pressure.	Repair as required.
engine speed.	Loose or damaged drive plate.	Repair or replace the drive plate.
	Damaged oil pan, contacting the oil	Inspect the oil pan.
	pump screen.	Inspect the oil pump screen.
		Repair or replace as required.
	Oil pump screen loose, damaged or	Inspect the oil pump screen.
	restricted.	Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	Inspect the piston, piston pin and cylinder bore.
		Repair as required.
	Excessive piston pin-to-piston clearance.	Inspect the piston, piston pin and the connecting rod.
		Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required.
		The connecting rod bearings.
		The connecting rods.
		The crankshaft pin journals.
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required.
		The crankshaft bearings.
		The crankshaft main journals.
		The cylinder block.
	Incorrect piston, piston pin and connecting rod installation	Verify the piston pins and connecting rods are installed correctly.
		Repair as required.
Engine noise under load.	Low oil pressure	Repair or replace as required.
	Excessive connecting rod bearing clearance.	Inspect the following components and repair as required :

	Excessive crankshaft bearing clearance.	<ul> <li>The connecting rod bearings.</li> <li>The connecting rods.</li> <li>The crankshaft.</li> </ul> Inspect the following components, and repair as required. <ul> <li>The crankshaft bearings.</li> <li>The crankshaft main journals.</li> </ul>
		The cylinder block.
Engine will not crank-crankshaft will not rotate.	<ul><li>Hydraulically locked cylinder.</li><li>Coolant/antifreeze in cylinder.</li><li>Oil in cylinder.</li><li>Fuel in cylinder.</li></ul>	<ul> <li>Remove spark plugs and check for fluid.</li> <li>Inspect for broken head gasket.</li> <li>Inspect for cracked engine block or cylinder head.</li> <li>Inspect for a sticking fuel injector and/or leaking fuel regulator.</li> </ul>
	Broken timing chain and/or timing chain and/or timing chain gears.	<ul><li>Inspect timing chain and gears.</li><li>Repair as required.</li></ul>
	Material in cylinder.  • Broken valve  • Piston material  • Foreign material	<ul> <li>Inspect cylinder for damaged components and/or foreign materials.</li> <li>Repair or replace as required.</li> </ul>
	Seized crankshaft or connecting rod bearings.	<ul><li>Inspect crankshaft and connecting rod bearing.</li><li>Repair as required.</li></ul>
	Bent or broken connecting rod.	<ul><li>Inspect connecting rods.</li><li>Repair as required.</li></ul>
	Broken crankshaft.	<ul><li>Inspect crankshaft.</li><li>Repair as required.</li></ul>

### **COMPONENTS**



### Torque : N.m (kgf.m, lb-ft)

1.	vvate	r pur	np p	ulley
----	-------	-------	------	-------

2. Water pump

3. O-ring

#### REMOVAL AND INSTALLATION

### **▲** WARNING

Never remove the radiator cap when the engine is hot. Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

- 1. Disconnect the negative battery terminal.
- 2. Loosen the drain plug (A), and drain the coolant.

### NOTICE

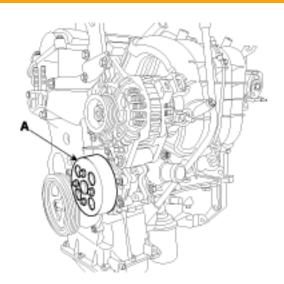
Remove the radiator cap to speed draining.



- 3. Remove the drive belt. (Refer to Timing System)
- 4. Remove the water pump pulley (A).

#### **Tightening torque:**

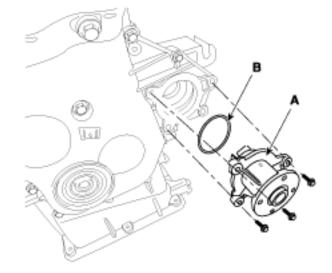
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



5. Remove the water pump (A) and O-ring (B).

#### Tightening torque:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



- 6. Install in the reverse order of removal.
- 7. Fill with engine coolant.
- 8. Start the engine and check for leaks.
- 9. Recheck the engine coolant level.

• Check engine coolant.

Poor coolant quality /

Maintenance check

### **TROUBLESHOOTING**

### Water Pump

Overheating

Damaged

impeller

Loosened

water Fullip					
Sy	mptoms	Possible	Causes	Remedy	
Coolant leakage	From the bleed     hole of the water	Visually check	Check leaks after about ten-minute	If coolant still leaks,     replace a water pump.	
	pump		warming up.	<ul> <li>If leakage stops, reuse the water pump (Do not replace the pump with a new one).</li> </ul>	
	From gaskets or bolts		Check the tightening of the water pump mounting bolts.	Retighten the mounting bolts.	
			Check damage of gaskets or inflow of dust.	Replace the gasket and clean dust off.	
	From outer     surface of water     pump		Check the material or any cracks of the water pump.	<ul> <li>Poor material. If any crack found, replace the water pump.</li> </ul>	
Noise	<ul> <li>From bearings</li> <li>From mechanical seals</li> <li>Impeller interference</li> </ul>	stethoscope e	After starting the engine, check noise with a stethoscope.	<ul> <li>If there is no noise, reuse the water pump (do not replace it).</li> </ul>	
				<ul> <li>If there is any noise from the water pump, remove the drive belt and recheck.</li> </ul>	
		Inspection after removing a drive belt	<ul> <li>After removing a water pump and a drive belt,</li> </ul>	If there is noise, reuse the water pump. Check other drive line parts.	
			check noise again.	<ul> <li>If there is no noise, replace the water pump with a new one.</li> </ul>	
		Inspection after removing a water pump	After removing a water pump and a drive belt, check noise again.	If there is any interference between them, replace the water pump with a new one.	

Loosened impeller

 Corrosion of the impeller wing

impeller	Impeller     seperation from     the shaft	Replace the water pump.

#### **ECM PROBLEM INSPECTION PROCEDURE**

1. TEST ECM GROUND CIRCUIT: Measure resistance between ECM and chassis ground using the backside of ECM harness connector as ECM side check point. If the problem is found, repair it.

**Specification:** below  $1\Omega$ 

- 2. TEST ECM CONNECTOR: Disconnect the ECM connector and visually check the ground terminals on ECM side and harness side for bent pins or poor contact pressure. If the problem is found, repair it.
- 3. If problem is not found in Step 1 and 2, the ECM could be faulty. If so, replace the ECM with a new one, and then check the vehicle again. If the vehicle operates normally then the problem was likely with the ECM.
- 4. RE-TEST THE ORIGINAL ECM: Install the original ECM (may be broken) into a known-good vehicle and check the vehicle. If the problem occurs again, replace the original ECM with a new one. If problem does not occur, this is intermittent problem.

(Refer to Intermittent Problem Procedure in Basic Inspection Procedure)

#### **REMOVAL**

### **▲** CAUTION

When replacing the ECM, the vehicle equipped with the immobilizer must be performed procedure as below.

[In the case of installing used ECM]

1) Perform "ECM Neutral mode" procedure with GDS.

(Refer to Body Electric System - "Immobilizer")

2) After finishing "ECM Neutral mode", perform "Key teaching" procedure with GDS.

(Refer to Body Electric System - "Immobilizer")

[In the case of installing new ECM]

Perform "Key teaching" procedure with GDS.

(Refer to Body Electric System - "Immobilizer")

### **▲** CAUTION

When replacing the ECM, the vehicle equipped with the smart key system (Button start) must be performed procedure as below.

[In the case of installing used ECM]

1) Perform "ECM Neutral mode" procedure with GDS.

(Refer to Body Electric System - "Smart key")

2) After finishing "ECM Neutral mode", insert the key (or press the start button) and turn it to the IGN ON and OFF position. Then the ECM learns the smart key information automatically.

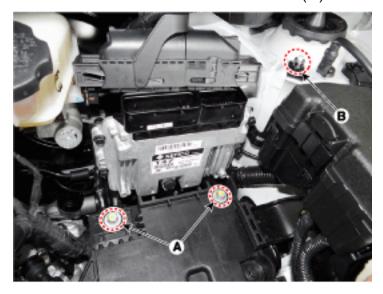
[In the case of installing new ECM]

Insert the key (or press the start button) and turn it to the IGN ON and OFF position. Then the ECM learns the smart key information automatically.

- 1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
- 2. Disconnect the ECM connector (A).



- 3. Remove the battery.
- 4. Remove the bracket installation bolts (A) and nut (B).



5. Remove the installation bolts (A), and then remove the ECM from the bracket.



### **INSTALLATION**

### **▲** CAUTION

When replacing the ECM, the vehicle equipped with the immobilizer must be performed procedure as below.

[In the case of installing used ECM]

1) Perform "ECM Neutral mode" procedure with GDS.

(Refer to Body Electric System - "Immobilizer")

2) After finishing "ECM Neutral mode", perform "Key teaching" procedure with GDS.

(Refer to Body Electric System - "Immobilizer")

[In the case of installing new ECM]

Perform "Key teaching" procedure with GDS.

(Refer to Body Electric System - "Immobilizer")

### **▲** CAUTION

When replacing the ECM, the vehicle equipped with the smart key system (Button start) must be performed procedure as below.

[In the case of installing used ECM]

1) Perform "ECM Neutral mode" procedure with GDS.

(Refer to Body Electric System - "Smart key")

2) After finishing "ECM Neutral mode", insert the key (or press the start button) and turn it to the IGN ON and OFF position. Then the ECM learns the smart key information automatically.

[In the case of installing new ECM]

Insert the key (or press the start button) and turn it to the IGN ON and OFF position. Then the ECM learns the smart key information automatically.

Install in the reverse order of removal.

#### **ECM** installation nut:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

#### **ECM** installation bolt:

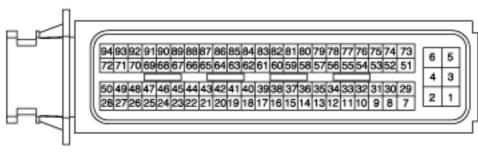
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

#### **ECM** bracket installation bolt/nut:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

### **ENGINE CONTROL MODULE (ECM)**

#### 1. Harness Connector



Connector [E100-K]

#### 2. Terminal Function

### Connector [E100-K]

No.	Description	Connected to		
1	ETC motor (+) control output	ETC Module		
2	ETC motor (-) control output	ETC Module		
3	Power Ground	Chassis Ground		
4	Power Ground	Chassis Ground		
5	Battery voltage supply after main relay	Main Relay		
6	Battery voltage supply after main relay	Main Relay		
7	Heated Oxygen Sensor [Bank 1/ Sensor 1] Heater control output	Heated Oxygen Sensor [Bank 1/ Sensor 1]		
8	Injector (Cylinder #2) control output	Injector (Cylinder #2)		
9	Injector (Cylinder #1) control output	Injector (Cylinder #1)		
10	Engine RPM signal output	EPS Control Module		
11	-			
12	Start switch signal input	Ignition switch		
13	Electric Load signal input (Defrost)	A/C Control Module, Outside Mirror		
14	A/C switch ON signal input	A/C Control Module		
15	-			
16	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]		
17	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Intake]		
18	Battery voltage supply after ignition switch	Ignition Switch		
19	Sensor power (+5V)	Accelerator Position Sensor (APS) #2		
20	Sensor power (+3.3V)	Throttle position sensor (TPS) #1,2 [ETC module]		
21	-			

22	Intake Air temperature sensor (IATS) signal input	Intake Air temperature sensor (IATS)		
23	Manifold absolute pressure sensor (MAPS) signal input	Manifold absolute pressure sensor (MAPS)		
24	Throttle position sensor (TPS) #1 signal input	Throttle position sensor (TPS) #1		
25	A/C Pressure Transducer (APT) signal input	A/C Pressure Transducer (APT)		
26	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Intake]		
27	Ignition coil (Cylinder #2, 3) control output	Ignition coil (Cylinder #2, 3)		
28	Ignition coil (Cylinder #1, 4) control output	Ignition coil (Cylinder #1, 4)		
29	Purge Control Solenoid Valve control output	Purge Control Solenoid Valve (PCSV)		
30	Battery voltage supply after main relay	Main Relay		
31	Cooling Fan Relay [Low] control output	Cooling Fan Relay		
32	-			
33	Clutch switch signal input	Clutch switch [M.T]		
34	Brake switch 1 signal input	Brake lamp relay , Brake switch		
35	-			
36	-			
37	A/C pressure switch signal input	A/C pressure switch		
38	Brake switch 2 signal input	Brake lamp relay , Brake switch		
39	Vehicle speed signal input	ABS/ESP Control Module [With ABS/ESP]		
40	Sensor ground	A/C Pressure Transducer (APT)		
41	Sensor ground	Accelerator Position Sensor (APS) #1		
40	0 (.5)()	Manifold absolute pressure sensor (MAPS)		
42	Sensor power (+5V)	A/C Pressure Transducer (APT)		
43	Sensor power (+5V)	Accelerator Position Sensor (APS) #1		
44	Engine coolant temperature sensor (ECTS) signal input	Engine coolant temperature sensor (ECTS)		
45	-			
46	-			
47	-			
48	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]		
49	-			
50	-			
51	Injector (Cylinder #3) control output	Injector (Cylinder #3)		
52	Fuel pump relay control output [Without smart key]	Fuel pump relay		
52	A/C compressor relay control output [With smart key]	A/C compressor relay		
53	Cooling Fan Relay [High] control output	Cooling Fan Relay		
54	Immobilizer Lamp control output	Immobilizer Lamp		
55	-			
56	Crankshaft Position Sensor signal input	Crankshaft Position Sensor (CKPS)		
57	C-CAN [High]	Other control module		
58	-			
59	CAN 2 [High]	Other control module		
60	Vehicle speed [B] signal input	Front wheel speed sensor (RH) [Without ABS/ESP]		

61	-					
62	-					
63	Sensor ground		Eng	ine Coolant	Temperature Sensor (ECT	S)
64	-					
65	Sensor ground	Sensor ground		Accelerator Position Sensor (APS) #2		
66	Heated Oxygen Sensor [Bank 1/ Sensor 2] signal input		Hea	ited Oxygen	Sensor [Bank 1/ Sensor 2]	
67	Accelerator Position Sensor (APS) #1	signal input	Acc	elerator Posi	ition Sensor (APS) #1	
68	-					
69	Accelerator Position Sensor (APS) #2	signal input	Accelerator Position Sensor (APS) #2			
70	Sensor ground		Knock sensor (KS)			
71	Heated Oxygen Sensor [Bank 1/ Sensor control output	or 2] Heater	Heated Oxygen Sensor [Bank 1/ Sensor 2]			
72	-					
73	-					
74	Injector (Cylinder #4) control output		Inje	ctor (Cylinde	r #4)	
	Fuel Pump Relay control output (With	smart key)	Fue	l Pump Rela	у	
75	A/C compressor relay control output (Without smart key)		A/C compressor relay			
76	Start relay control output		Start relay			
77	Power ground		Chassis ground			
78	Sensor ground		Crankshaft Position Sensor (CKPS)			
79	C-CAN [Low]		Other control module			
80	Immobilizer communication line		Immobilizer control module			
81	CAN 2 [Low]		Other control module			
82	Vehicle speed [A] signal input		Front wheel speed sensor (RH) [Without ABS/ESP]			
83	Sensor ground		Manifold absolute pressure sensor (MAPS)			
84	-					
85	Sensor ground		Throttle position sensor (TPS) #1,2 [ETC module]			
86	Sensor ground		Heated Oxygen Sensor [Bank 1/ Sensor 1,2]			
87	Heated Oxygen Sensor [Bank 1/ Sensor 1] signal input		Heated Oxygen Sensor [Bank 1/ Sensor 1]			
88	Throttle position sensor (TPS) #2 signal input		Throttle position sensor (TPS) #2 [ETC module]			
89	-					
90	-					
91	Knock sensor (KS) signal input		Knock sensor (KS)			
92	CVVT Oil Control Valve [Bank 1/Intake] control output		CVVT Oil Control Valve (OCV) [Bank 1/Intake]			
93	CVVT Oil Control Valve [Bank 1/Exhaust] control output		CVVT Oil Control Valve (OCV) [Bank 1/Exhaust]			
94	-					
3. Ter	3. Terminal input/output signal					
Conr	nector [E100-K]					
Pin	Description	Condition		Туре	Level	Test Result

No.					
1	ETC motor (+) control output		Dulas	Hi: Battery Voltage	13.8V
		ldle	Pulse	Lo: Max. 1.0V	20mV
2	ETC motor (-) control output		Dulas	Hi: Battery Voltage	13.8V
		ldle	Pulse	Lo: Max. 1.0V	200mV
3	Power Ground	Idle	DC	Max. 50mV	0mV
4	Power Ground	Idle	DC	Max. 50mV	3.6mV
5	Battery voltage supply after main relay	IG OFF	DC	Max. 1.0V	200mV
5		IG ON		Battery Voltage	12.9V
6	Battery voltage supply after main relay	IG OFF	DC	Max. 1.0V	200mV
0		IG ON	DC	Battery Voltage	12.9V
7	Heated Oxygen Sensor [Bank 1/ Sensor 1] Heater control output	Engine Dur	Pulse	Hi: Battery Voltage	14.2V
/		Engine Run	Fuise	Lo: Max. 1.0V	200mV
				Hi: Battery Voltage	13.6V
8	Injector (Cylinder #2) control output	Idle	Pulse	Lo: Max. 1.0V	336mV
				Vpeak: Max. 80V	69.7V
				Hi: Battery Voltage	13.6V
9	Injector (Cylinder #1) control output	ldle	Pulse	Lo: Max. 1.0V	336mV
				Vpeak: Max. 80V	69.7V
	Engine speed signal output	Idle		Hi: Battery Voltage	14.0V
10			Pulse	Lo: Max. 0.5V	20mV
				Freq.: 20 ~ 26Hz	22Hz
11	-				
12	Start switch signal input				
13	Electric Load signal input (Defrost)				
14	A/C switch ON signal input	A/C switch OFF	DC	Max. 0.5V	200mV
14		A/C switch ON		Battery Voltage	12.6V
15	Alternator load signal input	Idle	Pulse	Hi: Battery Voltage	13.2V
10				Lo: Max.1.5V	1.34V
16	Camshaft Position Sensor [Bank1/ Exhaust] signal input	ldle	Pulse	Hi: Battery Voltage	13.72V
10				Lo: Max. 0.5V	200mV
17	Camshaft Position Sensor [Bank1/ Intake] signal input	ldle	Pulse	Hi: Battery Voltage	13.72V
				Lo: Max. 0.5V	200mV
18	Battery voltage supply after ignition switch	IG OFF	DC	Max. 1.0V	3.2mV
10		IG ON		Battery Voltage	12.68V
19	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	3.6mV
		IG ON		4.8 ~ 5.2V	3.02V
20	Sensor power (+3.3V)	IG OFF	DC -	Max. 0.5V	5mV
		IG ON		3.2 ~ 3.4V	3.02V
21	-				
22	Intake Air Temperature Sensor signal	Idle	DC	0 ~ 5V	2.55V

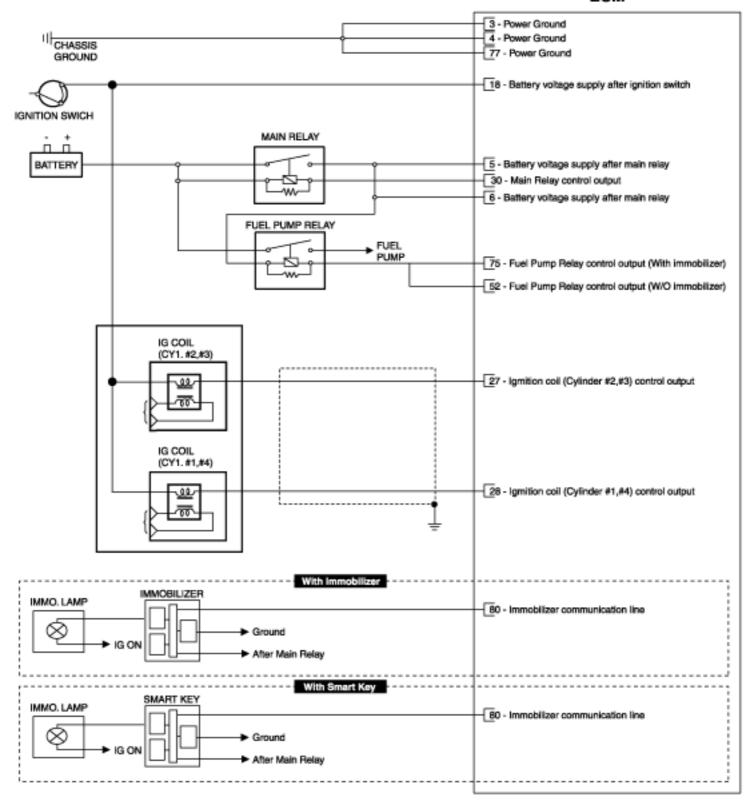
	input				
23	Manifold Absolute Pressure Sensor signal input	ldle	Analog	0.8 ~ 1.6V	1.37V
24	Throttle Position Sensor (TPS) #1	C.T	Analog	0.3 ~ 0.9V	0.65V
_ <del>24</del>	signal input	W.O.T	Analog	1.5 ~ 3.0V	1.63V
25	A/C Pressure Transducer (APT) signal input	A/C ON	Analog	Max. 4.8V	1.88V
26	Sensor ground	Idle	DC	Max. 50mV	12mV
27	Ignition coil (Cylinder #2, 3) control	ldle	Pulse	1st Voltage: 300 ~ 400V	352V
	output	idie	i disc	ON Voltage: Max. 2.0V	1.1V
28	Ignition coil (Cylinder #1, 4) control	ldle	Pulse	1st Voltage: 300 ~ 400V	366V
20	output	idle	i uise	ON Voltage: Max. 2.0V	1.1V
29	Purge Control Solenoid Valve control	Active	Pulse	Hi: Battery Voltage	14.2V
29	output	Inactive	Puise	Lo: Max. 1.0V	120mV
20	Main Dalay control output	Relay OFF	- DC	Battery Voltage	12.78V
30	Main Relay control output	Relay ON		Max. 1.0V	860mV
04	Cooling Fan Relay [Low] control	Relay OFF	DO	Battery Voltage	14.12V
31	output	Relay ON	- DC	Max. 1.0V	61.6mV
32	-				
33	Clutch switch signal input				
0.4		Brake ON DC Brake OFF	50	Battery Voltage	14.12V
34	Brake switch 1 signal input		DC	Max. 1.0V	61.6mV
35	-				
36	-				
07	A (O.D	A/C OFF	50	Max. 0.5V	200mV
37	A/C Pressure switch signal input	A/C ON	DC	Battery Voltage	12.6V
		ON	DC	Max. 0.5V	200mV
38	Brake switch 2 signal input	OFF	- DC	Battery Voltage	12.6V
				Hi: Min. 4.5V	12.2V
	.,	Idle	5.1	Lo: Max. 1.0V	0V
39	Vehicle speed signal input	Vehicle Run	Pulse	Hi: Min. 4.5V	12.2V
		(30km)	-	Lo: Max. 1.0V	0V
40	Sensor ground	Idle	DC	Max. 50mV	
41	Sensor ground	Idle	DC	Max. 50mV	
40	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	3.6mV
42		IG ON		4.9 ~ 5.1V	5.02V
	0 ( -1 ::	IG OFF	DC	Max. 0.5V	3.6mV
43	Sensor power (+5V)	IG ON		4.8 ~ 5.2V	5.02V
44	Engine Coolant Temperature Sensor signal input	ldle	Analog	0.5 ~ 4.5V	1.43V
45	-				
46	-				

47	-				
48	Sensor ground	Idle	DC	Max. 50mV	
49	-				
50	-				
				Hi: Battery Voltage	13.6V
51	Injector (Cylinder #3) control output	ldle	Pulse	Lo: Max. 1.0V	336mV
				Vpeak: Max. 80V	69.7V
	Fuel Pump Relay control	Relay OFF	DC	Battery Voltage	12.8V
52	output (Without smart key)	Relay ON	- DC	Max. 1.0V	40mV
52	A/C compressor relay control	A/C OFF	DC	Battery Voltage	14.3V
	output (With smart key)	A/C ON	DC	Max. 1.0V	102mV
<b>50</b>	Cooling Fan Relay [High] control	Relay OFF	DO	Battery Voltage	14.12V
53	output	Relay ON	- DC	Max. 1.0V	61.6mV
54	Immobilizer Lamp control output				
55	-				
	Crankshaft Position Sensor signal		SINE	)/ NA: 4 0)/	0.40\/
56	input	ldle	Wave	Vp_p: Min. 1.0V	6.48V
<i></i> 7	C CAN FUICLII	RECESSIVE	Dules	2.0 ~ 3.0V	2.5V
57	C-CAN [HIGH]	DOMINANT	- Pulse	2.75 ~ 4.5V	3.58V
58	-				
	C CAN II II CI II	RECESSIVE	Dulas	2.0 ~ 3.0V	2.5V
59	C-CAN [HIGH]	DOMINANT	- Pulse	2.75 ~ 4.5V	3.58V
60	Vehicle speed [B] signal input				
61	-				
62	-				
63	Sensor ground	Idle	DC	Max. 50mV	16.8mV
64	Sensor ground	Idle	DC	Max. 50mV	16.8mV
65	Sensor ground	Idle	DC	Max. 50mV	16.8mV
	Heated Oxygen Sensor (Bank1/	Desire	Analas	Rich: 0.6 ~ 1.0V	860mV
66	Sensor 2) signal input	Racing	Analog	Lean: Max. 0.4V	10mV
67	Accelerator Position Sensor (APS)	C.T	Analas	0.2 ~ 0.7V	0.5V
67	#1 signal input	W.O.T	- Analog	1.2 ~ 2.4V	2.1V
68	-				
60	Accelerator Position Sensor (APS)	C.T	Analas	0.2 ~ 0.7V	0.5V
69	#2 signal input	W.O.T	.T Analog	1.2 ~ 2.4V	2.1V
70	Sensor ground	Idle	DC	Max. 50mV	16.8mV
74	Heated Oxygen Sensor (Bank1/	Engine Run	Dulas	Hi: Battery Voltage	14.2V
71	Sensor 2) Heater control output	Engine Run	Pulse	Lo: Max. 1.0V	220mV
72	-				
73	-				
				Hi: Battery Voltage	13.6V

74	Injector (Cylinder #4) control output Idle		Pulse	Lo: Max. 1.0V	336mV
				Vpeak: Max. 80V	69.7V
	Fuel Pump Relay control	Relay OFF	DC	Battery Voltage	12.8V
75	output (With smart key)	Relay ON	DC	Max. 1.0V	40mV
75	A/C Compressor Relay control output	A/C OFF	DC	Battery Voltage	14.3V
	(Without smart key)	A/C ON		Max. 1.0V	102mV
76	Start relay control output (With smart	Relay OFF	DC	Battery Voltage	12.8V
70	key)	Relay ON		Max. 1.0V	40mV
77	Power ground	Idle	DC	Max. 50mV	3.6mV
78	Sensor ground	Idle	DC	Max. 50mV	3.6mV
79	C-CAN [LOW]	RECESSIVE	Pulse	2.0 ~ 3.0V	2.5V
19	C-CAN [LOVV]	DOMINANT	Fuise	0.5 ~ 2.25V	1.5V
80	Immobilizer communication line	When communicating	Pulse	Hi: Min. 8.5V	12.51V
00		after IG ON	Puise	Lo: Max. 3.5V	1.17V
81		RECESSIVE	Pulse	2.0 ~ 3.0V	2.5V
01	CAN 2 [LOW]	DOMINANT	Puise	0.5 ~ 2.25V	1.5V
82	Vehicle speed (A) signal input				
83	Sensor ground	Idle	DC	Max. 50mV	16mV
84	-				
85	Sensor ground	Idle	DC	Max. 50mV	11.2mV
86	Sensor ground	Idle	DC	Max. 50mV	6.2mV
87	Heated Oxygen Sensor (Bank1/ Sensor 1) signal input	Racing Analog	Analog -	Rich: 0.6 ~ 1.0V	884mV
07			Lean: Max. 0.4V		
88	Throttle Position Sensor (TPS) #2	C.T	Analog	4.2 ~ 5.0V	4.52V
	signal input	W.O.T	Analog	3.3 ~ 3.8V	3.68V
89	-				
90	-				
91	Knock Sensor signal input	Knocking	Variable		
	Trilock Gerisor signal input	Normal	Frequency		
92	CVVT Oil Control Valve [Bank1/	Idle	Pulse	Hi: Battery Voltage	14.9V
	Intake] control output	lule	Fuise	Lo: Max. 1.0V	36.2mV
93	CVVT Oil Control Valve [Bank1/	Idle	Pulse	Hi: Battery Voltage	14.9V
90	Exhaust] control output	iuic	1 0136	Lo: Max. 1.0V	36.2mV
94	-				

# **CIRCUIT DIAGRAM**

#### **ECM**

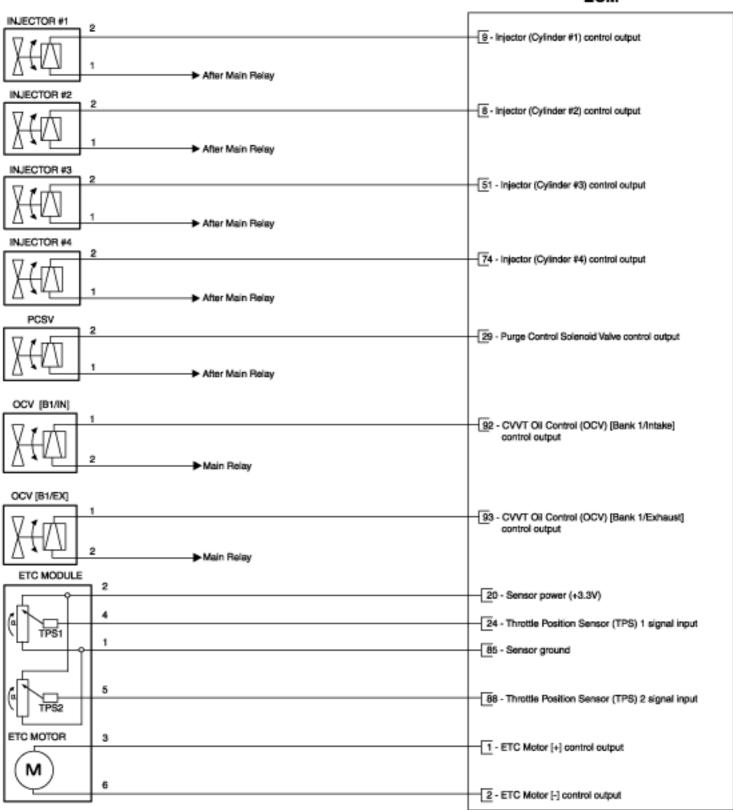


**ECM** MAP8 83 - Sensor ground -23 - MAPS signal input 42 - Sensor power (+5V) 3 -22 - IATS signal input ECTS 63 - Sensor ground 44 - ECTS signal input CMPS [B1/IN] Main Relay -17 - Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input 3 26 - Sensor ground CMPS [B1/EX] Main Relay -16 - Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input 48 - Sensor ground CKPS 78 - Sensor ground -56 - CKPS signal input sШN KS 70 - Sensor ground -91 - Knock Sensor (KS) signal input HO2S (B1/S1) After Main Relay -7 - HO2S (Sensor 1) Heater control output  $\mathcal{M}$ 87 - HO2S (Sensor 1) signal input 2 86 - Sensor ground HO2S (B1/S2) After Main Relay w -71 - HO2S (Sensor 2) Heater control output 66 - HO2S (Sensor 2) signal input 2 APT 40 - Sensor ground 42 - Sensor power (+5V) -25 - A/C Pressure Transducer signal input APS APS1 43 - Sensor power (+5V) 67 - Accelerator Position Sensor (APS) 1 signal input 41 - Sensor ground APS2 19 - Sensor power (+5V) - 69 - Accelerator Position Sensor (APS) 2 signal input 65 - Sensor ground Brake Switch -38 - Brake Switch Test signal input 3 IG ON ◀

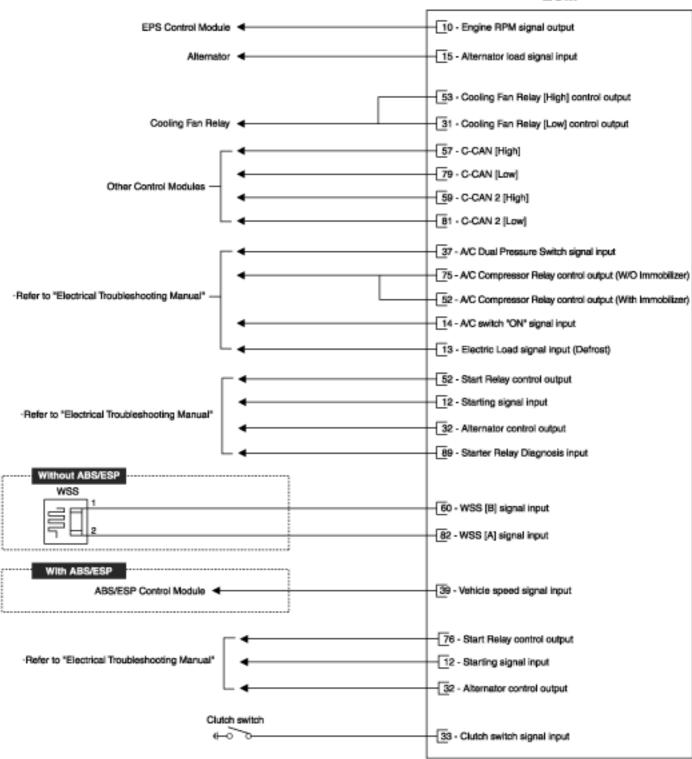
BATTERY(+) ◀

34 - Brake Switch Light signal input

#### **ECM**



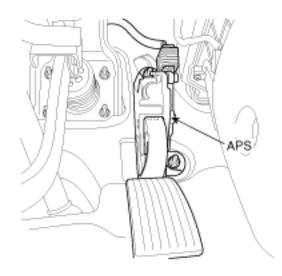
#### ECM



2016 > G 1.2 MPI > G 1.2 MPI > Engine Control / Fuel System > Engine Control System > Accelerator Position Sensor (APS) > Description and Operation

# **DESCRIPTION**

Accelerator Position Sensor (APS) is installed on the accelerator pedal module and detects the rotation angle of the accelerator pedal. The APS is one of the most important sensors in engine control system, so it consists of the two sensors which adapt individual sensor power and ground line. The second sensor monitors the first sensor and its output voltage is half of the first one. If the ratio of the sensor 1 and 2 is out of the range (approximately 1/2), the diagnostic system judges that it is abnormal.



# **INSPECTION**

- 1. Connect the GDS on the Diagnosis Link Connector (DLC).
- 2. Start engine and check output voltages of APS 1 and 2 at C.T and W.O.T.

**Specification:** Refer to Specification Section.

#### **CIRCUIT DIAGRAM**

#### [Circuit Diagram]

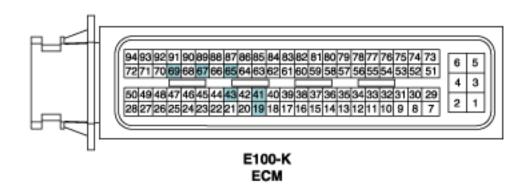
# APS (E144) APS 1 3 43 - Sensor Power (+5V) 67 - APS 1 Signal 41 - Sensor Ground APS 2 2 19 - Sensor Power (+5V) 69 - APS 2 Signal 65 - Sensor Ground

#### [Connection Information]

Terminal	Connected to	Function
1	ECM E100-K (69)	Sensor power (+5V)
2	ECM E100-K (19)	Sensor power (+5V)
3	ECM E100-K (43)	Sensor ground
4	ECM E100-K (67)	APS 1 Signal
5	ECM E100-K (41)	Sensor ground
6	ECM E100-K (65)	APS 2 Signal

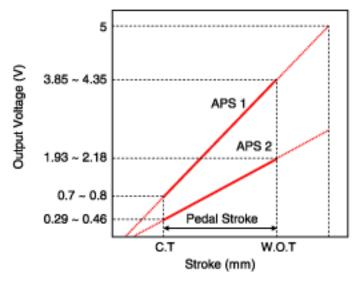
#### [Harness Connector]





# **SPECIFICATION**

Accelerator	Output Voltage (V) [Vref = 5V]	
Position	APS1	APS2
C.T	0.7 ~ 0.8	0.29 ~ 0.46
W.O.T	3.85 ~ 4.35	1.93 ~ 2.18

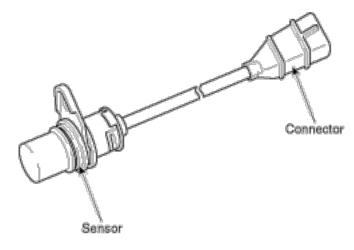


2016 > G 1.2 MPI > G 1.2 MPI > Engine Control / Fuel System > Engine Control System > Crankshaf Position Sensor (CKPS) > Description and Operation

# **DESCRIPTION**

Crankshaft Position Sensor (CKPS) detects the crankshaft position and is one of the most important sensors of the engine control system. If there is no CKPS signal input, the engine may stop because of CKPS signal missing.

This sensor is installed in ladder frame and generates alternating current by magnetic flux field which is made by the sensor and the target wheel when the engine rotates. The target wheel consists of 58 slots and 2 missing slots on 360 CA (Crank Angle).



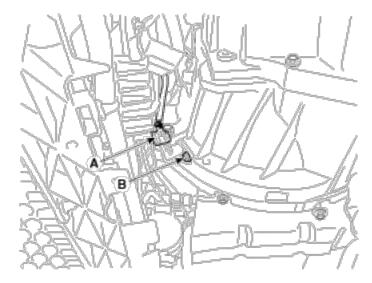
#### **INSPECTION**

1. Check signal waveform of CKPS and CMPS using a scan tool.

Specification: Refer to "Waveform"

#### **REMOVAL**

- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- 2. Disconnect the crankshaft position sensor connector (A).
- 3. Lift the vehicle.
- 4. Remove the CKP sensor after removing the installation bolt (B).



#### INSTALLATION

# **▲** CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. If the component has been dropped, inspect before installing.

# **▲** CAUTION

- Apply the engine oil to the O-ring.
- Insert the sensor in the installation hole and be careful not to damage.
- 1. Install in the reverse order of removal.

**Crankshaft position sensor installation bolt:** 

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

#### **CIRCUIT DIAGRAM**

#### [Circuit Diagram]

# CKPS (E114-2) 1 78 - CKPS Ground 2 N S 56 - CKPS Signal

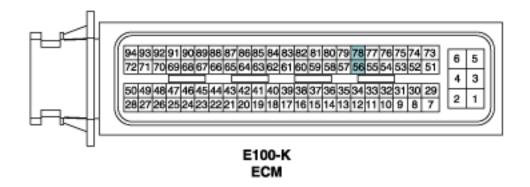
#### [Conection Information]

Terminal	Conected to	Function
1	ECM E100-K (78)	CKPS Ground
2	ECM E100-K (56)	CKPS Signal

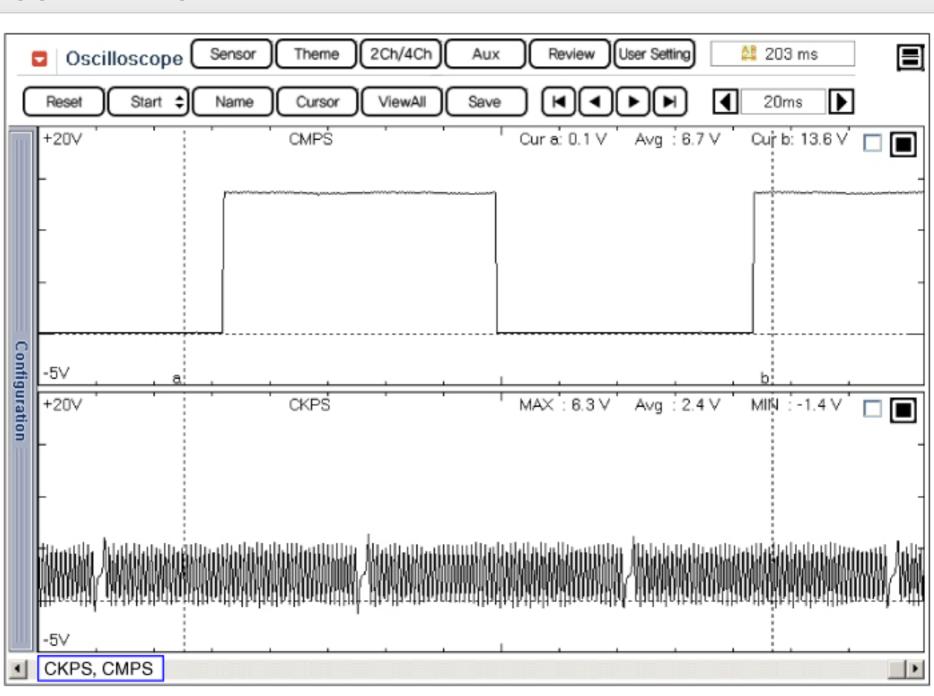
#### [Harness Connector]

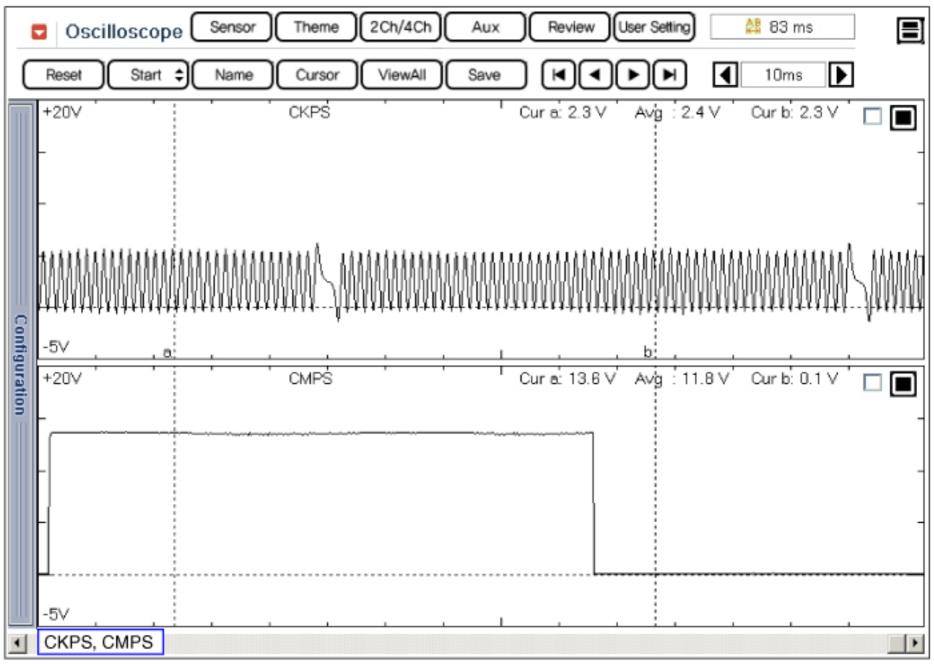






# **SIGNAL WAVEFORM**





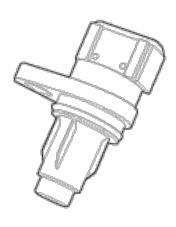
This example shows a typical Crankshaft Position Sensor(CkPS) and Camshaft Position Sensor(CMPS) waveform at idle. The PCM controls the injection and ignition timing by using these signals.

Generally CkPS signal is used to detect the piston's position and CMPS signal is used to detect the Top Dead Center of each cylinder.

2016 > G 1.2 MPI > G 1.2 MPI > Engine Control / Fuel System > Engine Control System Position Sensor (CMPS) > Description and Operation



Camshaft Position Sensor (CMPS) is a hall sensor and detects the camshaft position by using a hall element. It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of each cylinder which the CKPS can't detect. The CMPS is installed on engine head cover and uses a target wheel installed on the camshaft. This sensor has a hall-effect IC which output voltage changes when magnetic field is made on the IC with current flow.



#### **INSPECTION**

1. Check signal waveform of CKPS and CMPS using a scan tool.

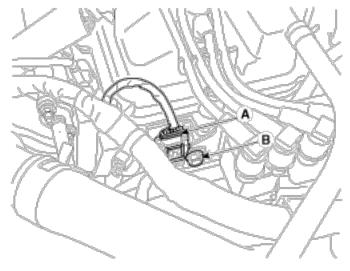
Specification: Refer to "Waveform"

#### **REMOVAL**

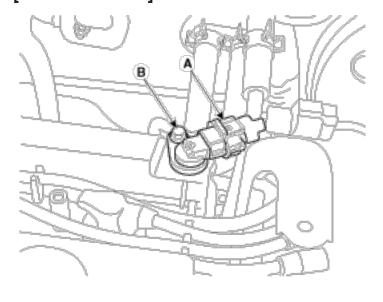
# **▲** WARNING

- DON'T remove the camshaft position sensor during engine running or right after engine stops, or a scald by the flowed out engine oil may occur.
- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- Remove the air duct.
   (Refer to Engine Mechanical System "Intake and Exhaust System")
- 3. Disconnect the camshaft position sensor connector (A).
- 4. Remove the installation bolt (B), and then remove the sensor.

#### [Bank 1/Intake]



#### [Bank 1/Exhaust]



#### **INSTALLATION**

# **▲** CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

# **▲** CAUTION

• Apply the engine oil to the O-ring.

# **▲** CAUTION

Insert the sensor in the installation hole and be careful not to damage when installation.

# **▲** CAUTION

- Be careful not to damage the sensor housing and the connector.
- Be careful not to damage the O-ring.
- 1. Install in the reverse order of removal.

#### **Camshaft position sensor installation bolt:**

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

#### **CIRCUIT DIAGRAM**

#### [Circuit Diagram]

#### 

#### [Connection Information]

#### CMPS [B1/IN] (E113-1)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM E100-K (17)	CMPS [B1/IN] Signal
3	ECM E100-K (26)	Sensor Ground

#### CMPS [B1/EX] (E113-2)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM E100-K (16)	CMPS [B1/EX] Signal
3	ECM E100-K (48)	Sensor Ground

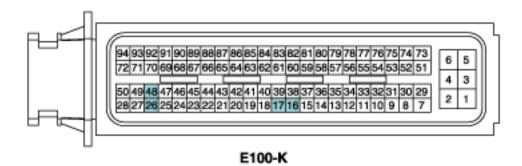
#### [Harness Connector]





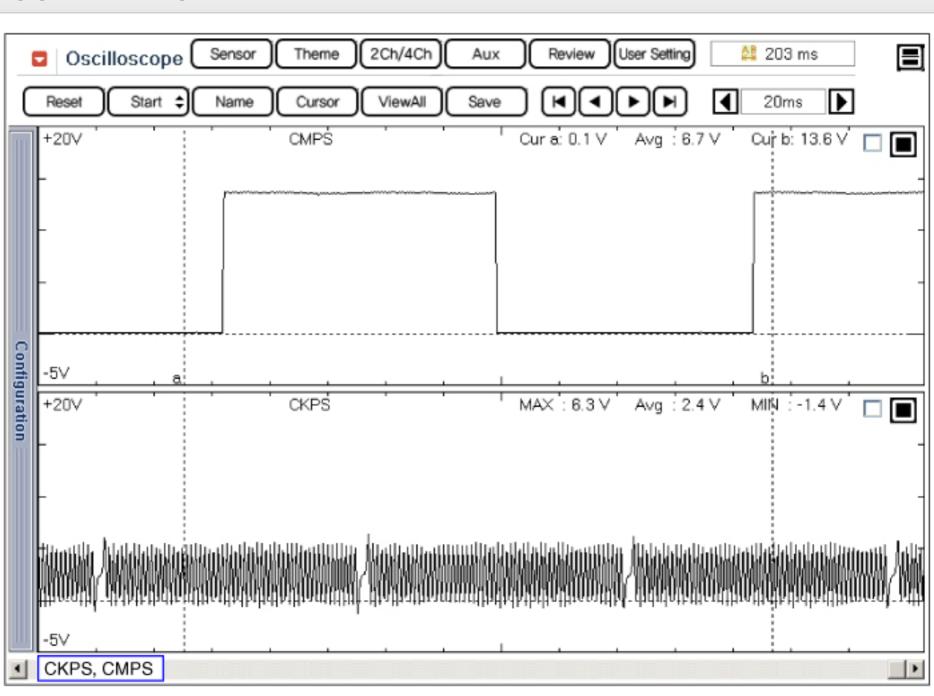


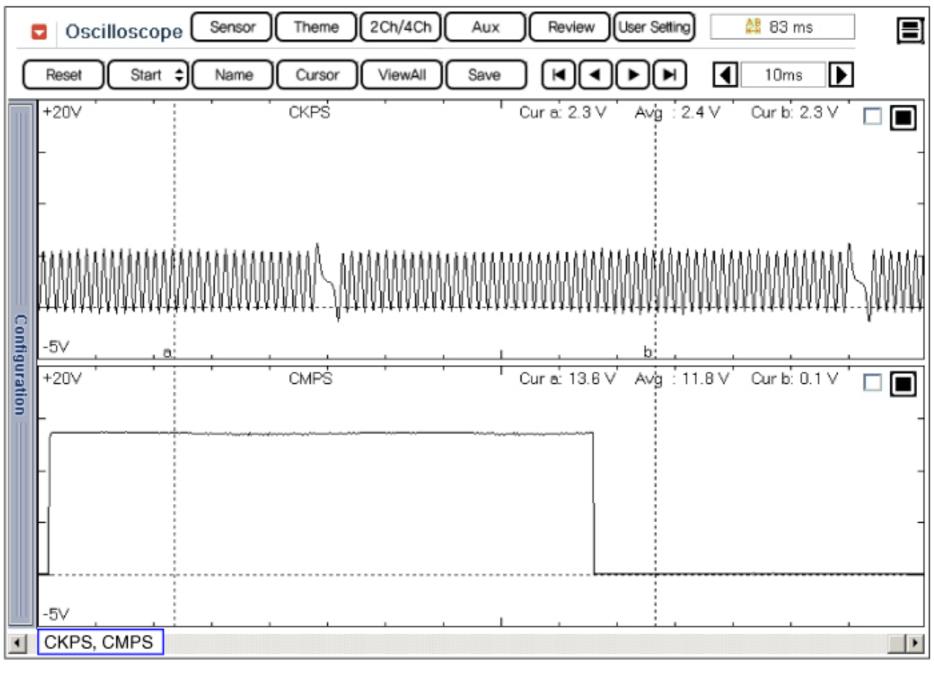
E113-2 CMPS [B1/EX]



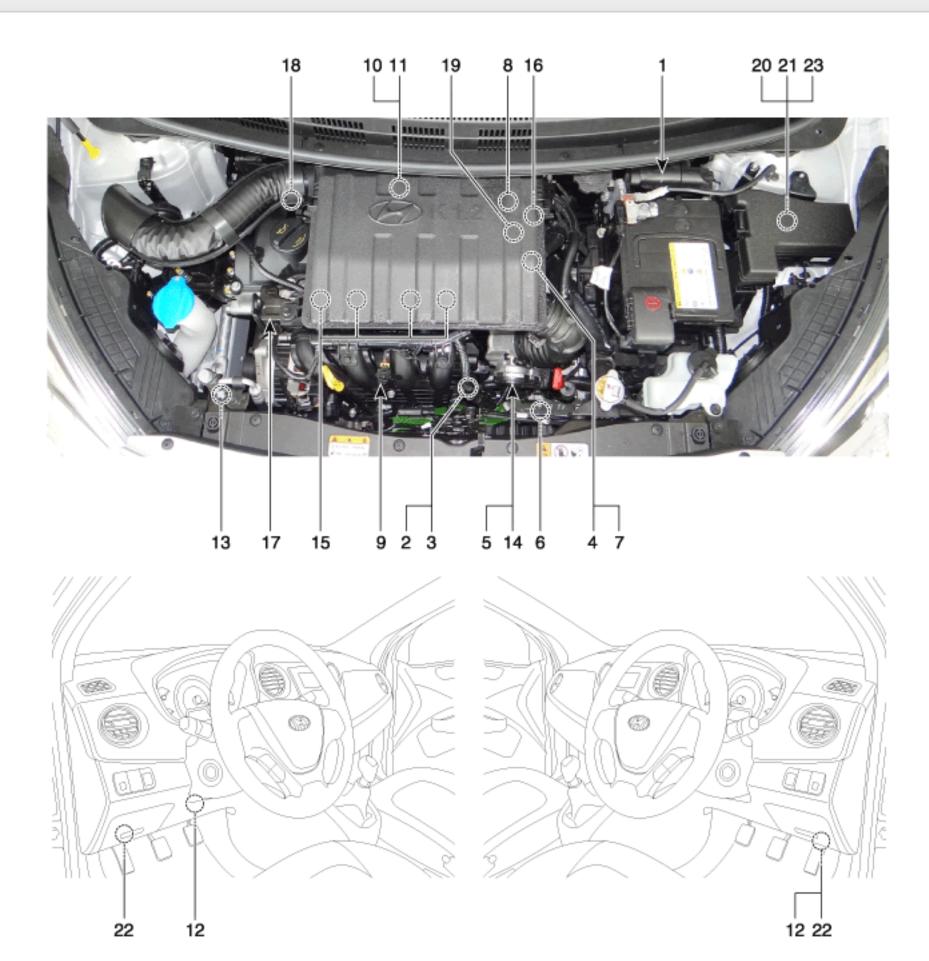
**ECM** 

# **SIGNAL WAVEFORM**





#### **COMPONENTS LOCATION**

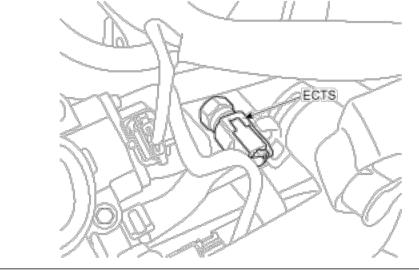


- 1 . ECM (Engine control module)
- 2. Manifold absolute pressure sensor (MAPS)
- 3 . Intake air temperature sensor (IATS)
- 4 . Engine coolant temperature sensor (ECTS)
- 5 . Throttle Position Sensor (TPS) [integrated into ETC Module]
- 6. Crankshaft Position Sensor (CKPS)
- 7. Camshaft Position Sensor (CMPS) [Bank 1 / Intake]
- 8 . Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust]

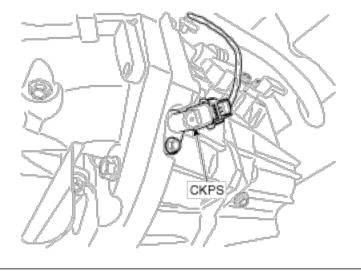
- 12. Accelerator Position Sensor (APS)
- 13 . A/C Pressure Transducer (APT)
- 14. ETC Motor [integrated into ETC Module]
- 15 . Injector
- 16 . Purge control solenoid valve (PCSV)
- 17 . CVVT Oil Control Valve (OCV) [Bank 1 / Intake]
- 18 . CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust]
- 19 . Ignition coil
- 20. Main relay

- 9 . Knock sensor (KS)
- 10 . Heated oxygen sensor (HO2S) [Bank 1/Sensor 1] 11 . Heated oxygen sensor (HO2S) [Bank 1/Sensor 2]
- 21. Fuel pump relay
- 22. Data link connector (DLC) [16Pin]
- 23. Multi-Purpose Check Connector [6 Pin]

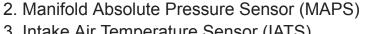
- 1. ECM (Engine Control Module)
- 4. Engine Coolant Temperature Sensor (ECTS)

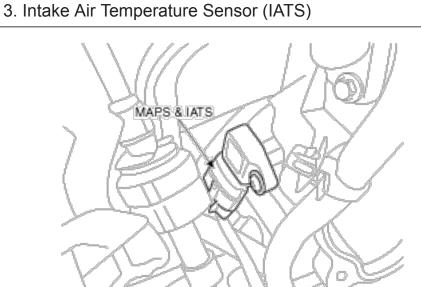


6. Crankshaft Position Sensor (CKPS)



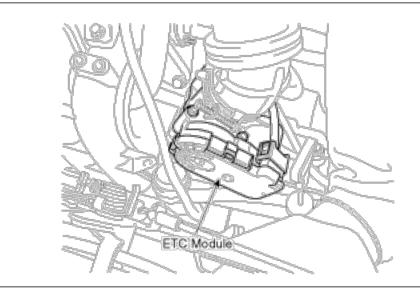
8. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust]



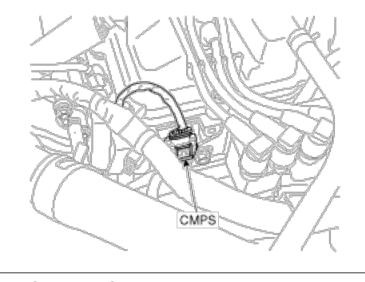


5. Throttle Position Sensor (TPS) [integrated into ETC Module]

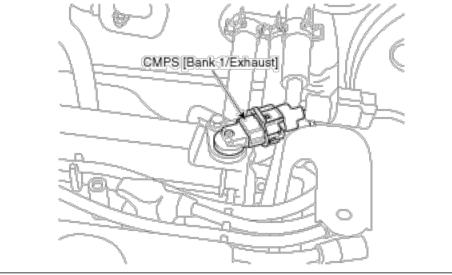
14. ETC Motor [integrated into ETC Module]



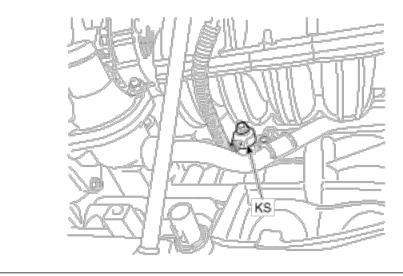
7. Camshaft Position Sensor (CMPS) [Bank 1 / Intake]



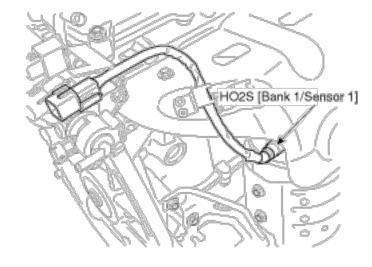
9. Knock Sensor (KS)



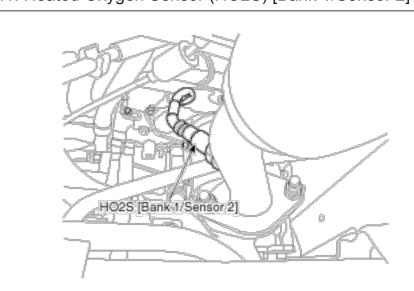
10. Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]



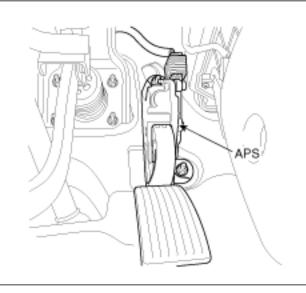
11. Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]



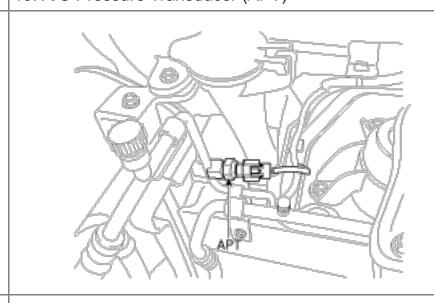
12. Accelerator Position Sensor (APS)



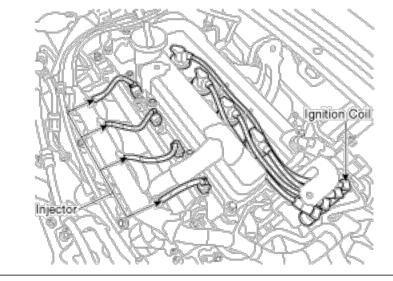
13. A/C Pressure Transducer (APT)



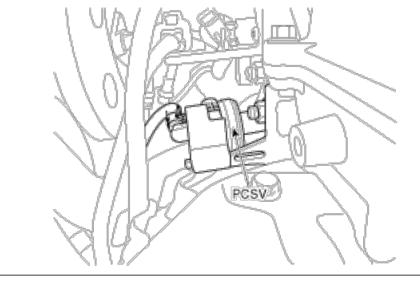
15. Injector19 . Ignition coil



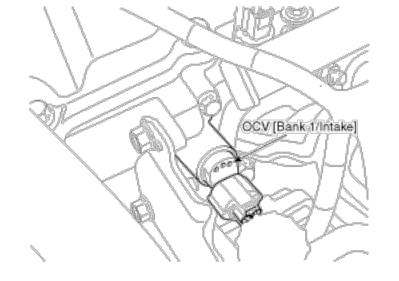
16. Purge Control Solenoid Valve (PCSV)

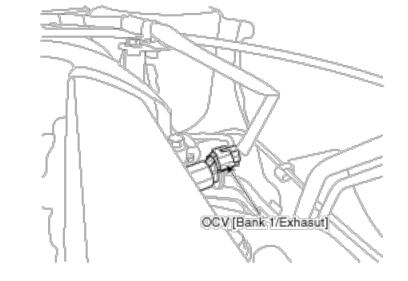


17. CVVT Oil Control Valve (OCV) [Bank 1 / Intake]

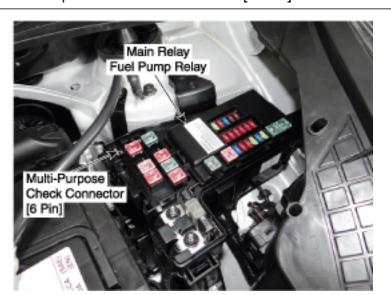


18. CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust]

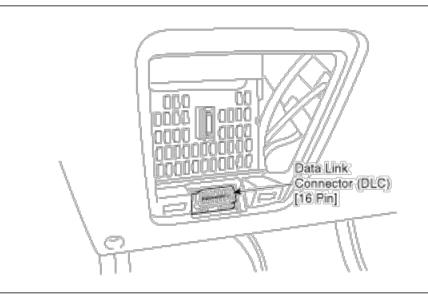




- 20. Main Relay
- 21. Fuel Pump Relay
- 23. Multi-Purpose Check Connector [6 Pin]



22. Data Link Connector (DLC) [16 Pin]



#### **DESCRIPTION**

Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load.

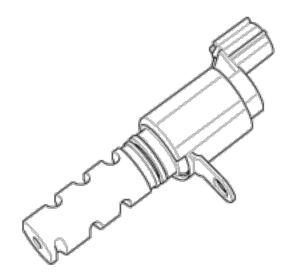
By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NOx, HC) and improves engine performance through reduction of pumping loss, internal EGR effect, improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.

This system consist of

-the CVVT Oil Control Valve (OCV) which supplies the engine oil to the cam phaser or runs out the engine oil from the cam phaser in accordance with the ECM PWM (Pulse With Modulation) control signal,

-and the Cam Phaser which varies the cam phase by using the hydraulic force of the engine oil.

The engine oil getting out of the CVVT oil control valve varies the cam phase in the direction (Intake Advance/Exhaust Retard) or opposite direction (Intake Retard/Exhaust Advance) of the engine rotation by rotating the rotor connected with the camshaft inside the cam phaser.



#### **INSPECTION**

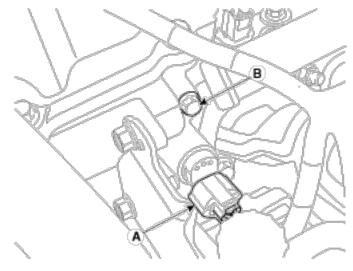
- 1. Turn the ignition switch OFF.
- 2. Disconnect the OCV connector.
- 3. Measure resistance between the OCV terminals 1 and 2.
- 4. Check that the resistance is within the specification.

Specification: Refer to "Specification"

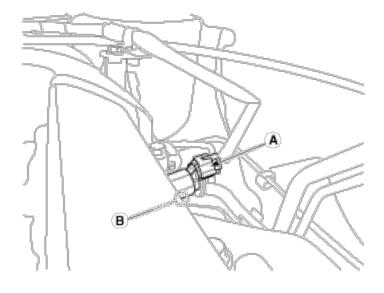
#### **REMOVAL**

- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- 2. Disconnect the CVVT oil control valve connector (A).
- 3. Remove the installation bolt (B), and then remove the valve from the engine.

#### [Bank 1/Intake]



#### [Bank 1/Exhaust]



#### **INSTALLATION**



- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

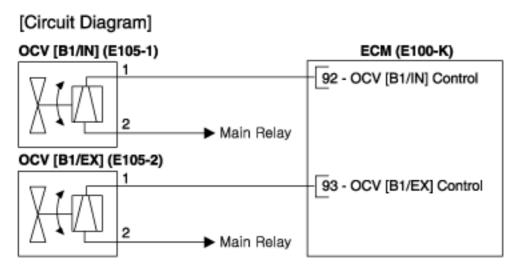
# **▲** CAUTION

- Apply the engine oil to the valve O-ring.
- 1. Install in the reverse order of removal.

#### **CVVT** oil control valve installation bolt:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

#### **CIRCUIT DIAGRAM**



#### [Connection Information]

#### OCV [B1/IN] (E105-1)

ı	Terminal	Connected to	Function
	1	ECM E100-K (92)	OCV [B1/IN] Control
	2	Main Relay	Battery Power (B+)

#### OCV [B1/EX] (E105-2)

Terminal	Connected to	Function
1	ECM E100-K (93)	OCV [B1/EX] Control
2	Main Relay	Battery Power (B+)

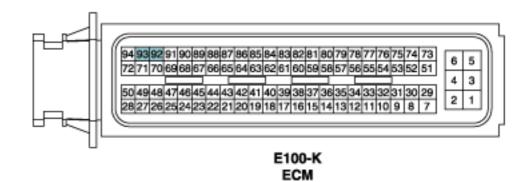
#### [Harness Connector]







E105-2 OCV [B1/EX]



2016 > G 1.2 MPI > G 1.2 MPI > Engine Control / Fuel System > Engine Control System > C/VT Oil Control Valve (OCV) > Specifications

# **SPECIFICATION**

Item	Specification
Coil Resistance (Ω)	6.9 ~ 7.9 [20°C(68°F)]

#### **DESCRIPTION**

If the Gasoline Engine Control system components (sensors, ECM, injector, etc.) fail, interruption to the fuel supply or failure to supply the proper amount of fuel for various engine operating conditions will result. The following situations may be encountered.

- 1. Engine is hard to start or does not start at all.
- 2. Unstable idle.
- 3. Poor driveability

If any of the above conditions are noted, first perform a routine diagnosis that includes basic engine checks (ignition system malfunction, incorrect engine adjustment, etc.). Then, inspect the Gasoline Engine Control system components with the HI-SCAN (Pro).

#### NOTICE

- Before removing or installing any part, read the diagnostic trouble codes and then disconnect the battery negative (-) terminal.
- Before disconnecting the cable from battery terminal, turn the ignition switch to OFF. Removal or connection of the battery cable during engine operation or while the ignition switch is ON could cause damage to the ECM.
- The control harnesses between the ECM and heated oxygen sensor are shielded with the shielded ground wires to the body in order to prevent the influence of ignition noises and radio interference. When the shielded wire is faulty, the control harness must be replaced.
- When checking the generator for the charging state, do not disconnect the battery '+' terminal to prevent the ECM from damage due to the voltage.
- When charging the battery with the external charger, disconnect the vehicle side battery terminals to prevent damage to the ECM.

# Malfunction Indicator Lamp (MIL)

## [EOBD]

A malfunction indicator lamp illuminates to notify the driver that there is a problem with the vehicle. However, the MIL will go off automatically after 3 subsequent sequential driving cycles without the same malfunction. Immediately after the ignition switch is turned on (ON position - do not start), the MIL will illuminate continuously to indicate that the MIL operates normally. Faults with the following items will illuminate the MIL.

- Catalyst
- Fuel system
- Mass Air Flow Sensor (MAFS)
- Intake Air Temperature Sensor (IATS)
- Engine Coolant Temperature Sensor (ECTS)
- Throttle Position Sensor (TPS)
- Upstream Oxygen Sensor
- Upstream Oxygen Sensor Heater
- Downstream Oxygen Sensor
- Downstream Oxygen Sensor Heater
- Injector

- Misfire
- Crankshaft Position Sensor (CKPS)
- Camshaft Position Sensor (CMPS)
- Evaporative Emission Control System
- Vehicle Speed Sensor (VSS)
- Idle Speed Control Actuator (ISCA)
- Power Supply
- ECM/ PCM
- MT/AT Encoding
- Acceleration Sensor
- MIL-on Request Signal
- Power Stage

#### NOTICE

Refer to "Inspection CHART FOR DIAGNOSTIC TROUBLE CODES (DTC)" for more information.

# [NON-EOBD]

A malfunction indicator lamp illuminates to notify the driver that there is a problem with the vehicle. However, the MIL will go off automatically after 3 subsequent sequential driving cycles without the same malfunction. Immediately after the ignition switch is turned on (ON position - do not start), the MIL will illuminate continuously to indicate that the MIL operates normally. Faults with the following items will illuminate the MIL

- Heated oxygen sensor (HO2S)
- Mass air flow sensor (MAFS)
- Throttle position sensor (TPS)
- Engine coolant temperature sensor (ECTS)
- Idle speed control actuator (ISCA)
- Injectors
- ECM

#### NOTICE

Refer to "Inspection CHART FOR DIAGNOSTIC TROUBLE CODES (DTC)" for more information.

# [Inspection]

- 1. After turning ON the ignition key, ensure that the light illuminates for about 5 seconds and then goes out.
- 2. If the light does not illuminate, check for an open circuit in the harness, a blown fuse or a blown bulb.

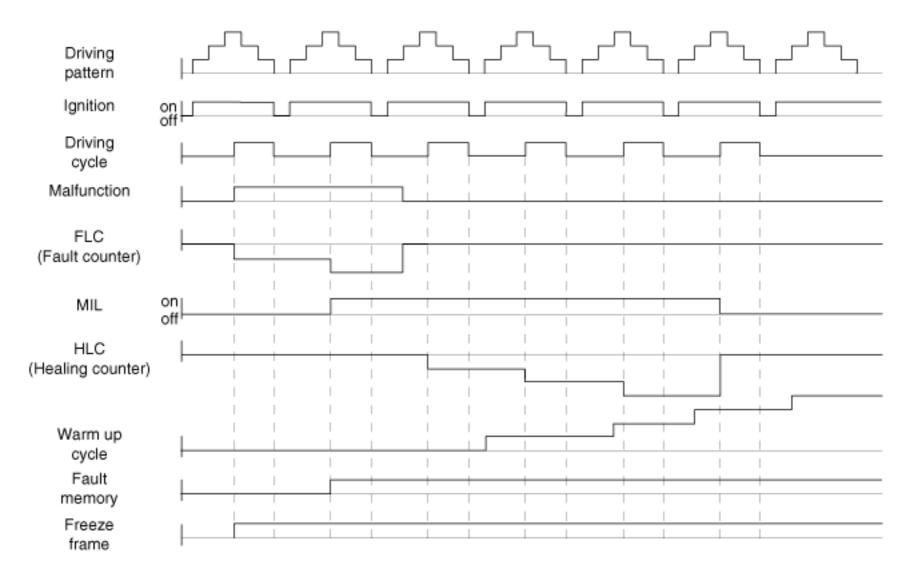
## Self-Diagnosis

The ECM monitors the input/output signals (some signals at all times and the others under specified conditions). When the ECM detects an irregularity, it records the diagnostic trouble code, and outputs the signal to the Data Link connector. The diagnosis results can be read with the MIL or HI-SCAN (Pro). Diagnostic Trouble Codes (DTC) will remain in the ECM as long as battery power is maintained. The diagnostic trouble codes will, however, be erased when the battery terminal or ECM connector is disconnected, or by the HI-SCAN (Pro).



If a sensor connector is disconnected with the ignition switch turned on, the diagnostic trouble code (DTC) is recorded. In this case, disconnect the battery negative terminal (-) for 15 seconds or more, and the diagnosis memory will be erased.

#### The Relation Between DTC And Driving Pattern In EOBD System



- 1. When the same malfunction is detected and maintained during two sequential driving cycles, the MIL will automatically illuminate.
- 2. The MIL will go off automatically if no fault is detected after 3 sequential driving cycles.
- 3. A Diagnostic Trouble Code(DTC) is recorded in ECM memory when a malfunction is detected after two sequential driving cycles. The MIL will illuminate when the malfunction is detected on the second driving cycle. If a misfire is detected, a DTC will be recorded, and the MIL will illuminate, immediately after a fault is first detected.
- 4. A Diagnostic Trouble Code(DTC) will automatically erase from ECM memory if the same malfunction is not detected for 40 driving cycles.

#### NOTICE

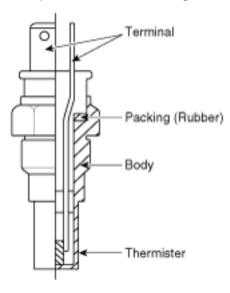
- A "warm-up cycle" means sufficient vehicle operation such that the coolant temperature has risen by at least 40 degrees Fahrenheit from engine starting and reaches a minimum temperature of 160 degrees Fahrenheit.
- A "driving cycle" consists of engine startup, vehicle operation beyond the beginning of closed loop operation.

# **DESCRIPTION**

Engine Coolant Temperature Sensor (ECTS) is located in the engine coolant passage of the cylinder head for detecting the engine coolant temperature. The ECTS uses a thermistor whose resistance changes with the temperature.

The electrical resistance of the ECTS decreases as the temperature increases, and increases as the temperature decreases. The reference +5V is supplied to the ECTS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the ECTS are connected in series. When the resistance value of the thermistor in the ECTS changes according to the engine coolant temperature, the output voltage also changes.

During cold engine operation, the ECM increases the fuel injection duration and controls the ignition timing using the information of engine coolant temperature to avoid engine stalling and improve drivability.





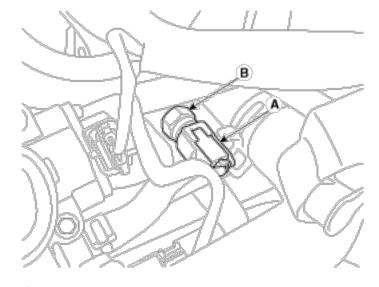
#### INSPECTION

- 1. Turn ignition switch OFF.
- 2. Disconnect ECTS connector.
- 3. Remove the ECTS.
- 4. After immersing the thermistor of the sensor into engine coolant, measure resistance between ECTS terminals 1 and 3.
- 5. Check that the resistance is within the specification.

Specification: Refer to "Specification"

#### **REMOVAL**

- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- Remove the air duct.
   (Refer to Engine Mechanical System "Intake And Exhaust System")
- 3. Disconnect the engine coolant temperature sensor connector (A).
- 4. Removal the water temperature sensor (B).



# **▲** CAUTION

Note that engine coolant may be flowed out from the water temperature control assembly when removing the sensor.

Supplement the engine coolant.
 (Refer to Engine Mechanical System - "Coolant")

#### **INSTALLATION**



Install the component with the specified torques.

• Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

### **▲** CAUTION

• Apply the engine coolant to the O-ring.

### **▲** CAUTION

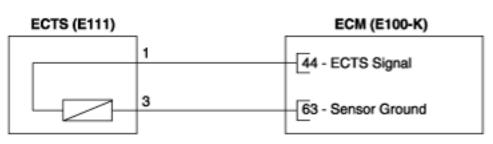
- Insert the sensor in the installation hole and be careful not to damage when installation.
- 1. Install in the reverse order of removal.

#### **Engine coolant temperature sensor installation:**

19.6 ~ 39.2 N.m (2.0 ~ 4.0 kgf.m, 14.4 ~ 28.9 lb-ft)

#### **CIRCUIT DIAGRAM**

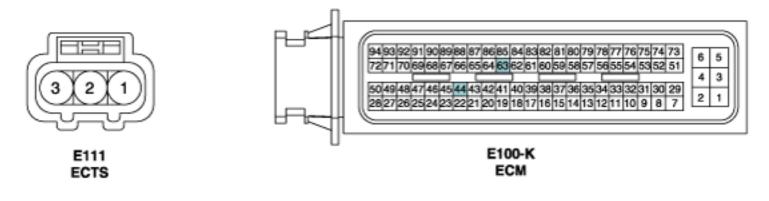
#### [Circuit Diagram]



#### [Conection Information]

Terminal	Conected to	Function
1	ECM E100-K (44)	ECTS Signal
2	-	-
3	ECM E100-K (63)	Sensor Ground

#### [Harness Connector]



2016 > G 1.2 MPI > G 1.2 MPI > Engine Control / Fuel System > Engine Control System > Engine Coolant Temperature Sensor (ECTS) > Specifications

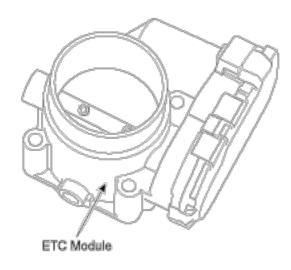
### **SPECIFICATION**

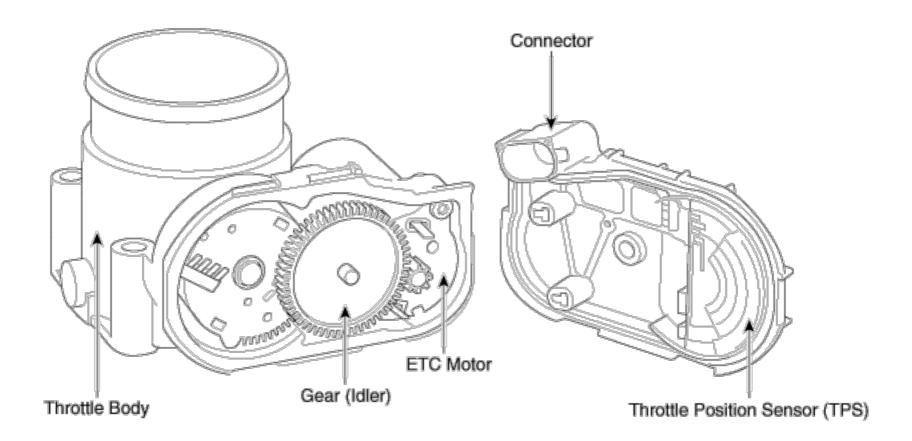
Temperature [°C(°F)]	Resistance(kΩ)
-40(-40)	48.14
-20(-4)	14.13 ~ 16.83
0(32)	5.79
20(68)	2.31 ~ 2.59
40(104)	1.15
60(140)	0.59
80(176)	0.32

2016 > G 1.2 MPI > G 1.2 MPI > Engine Control / Fuel System > Engine Control System (Electronic Throttle Control) System > Description and Operation

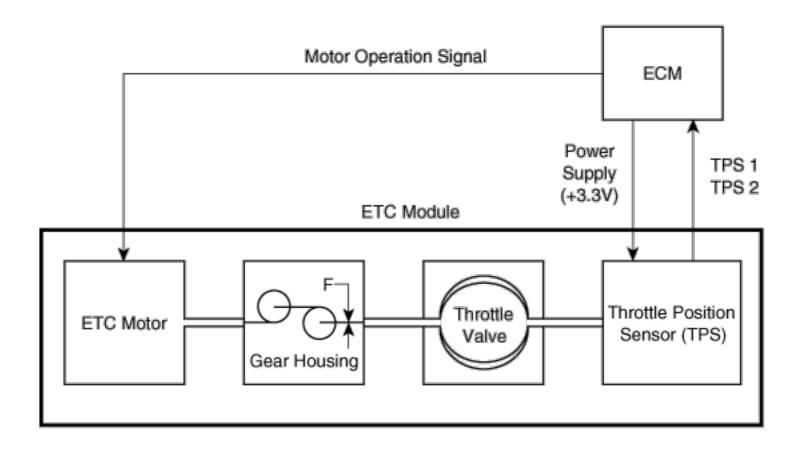
#### **DESCRIPTION**

The Electronic Throttle Control (ETC) System consists of a throttle body with an integrated control motor and throttle position sensor (TPS). Instead of the traditional throttle cable, an Accelerator Position Sensor (APS) is used to receive driver input. The ECM uses the APS signal to calculate the target throttle angle; the position of the throttle is then adjusted via ECM control of the ETC motor. The TPS signal is used to provide feedback regarding throttle position to the ECM. Using ETC, precise control over throttle position is possible; the need for external cruise control modules/cables is eliminated.





#### **SCHEMATIC DIAGRAM**



#### **INSPECTION**

### Throttle Position Sensor (TPS)

- 1. Connect the GDS on the Data Link Connector (DLC).
- 2. Start the engine and measure the output voltage of TPS 1 and 2 at C.T. and W.O.T.

Throttle Angle	Output Voltage	V) [Vref = 3.3V]
Tillottle Aligie	TPS 1	TPS 2
C.T	0.20 ~ 0.46	2.84 ~ 3.10
W.O.T	2.94 ~ 3.20	0.10 ~ 0.36

- 3. Turn the ignition switch OFF and disconnect the scantool from the DLC.
- 4. Disconnect the ETC module connector and measure the resistance between the ETC module terminals 1 and 2.

Specification: Refer to "Sensor Resistance"

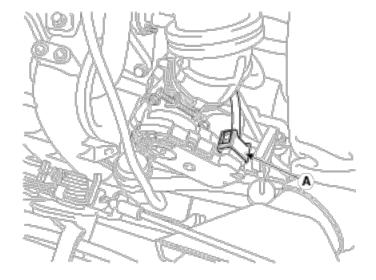
#### **ETC Motor**

- 1. Turn the ignition switch OFF.
- 2. Disconnect the ETC module connector.
- 3. Measure resistance between the ETC module terminals 3 and 6.
- 4. Check that the resistance is within the specification.

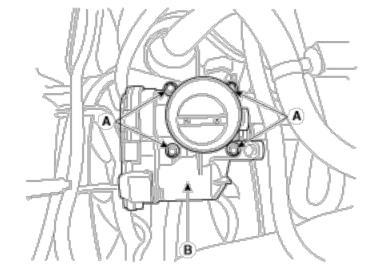
Specification: Refer to "Specification"

#### **REMOVAL**

- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- Remove the resonator and the air intake hose.
   (Refer to Engine Mechanical System "Intake And Exhaust System")
- 3. Disconnect the ETC module connector (A).



4. Remove the installation bolts (A), and then remove the ETC module (B) from the engine.



### **INSTALLATION**

### **▲** CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. If the component has been dropped, inspect before installing.
- 1. Install in the reverse order of removal.

**Electronic throttle body Installation bolt:** 

 $9.8 \sim 11.8 \text{ N.m} (1.0 \sim 1.2 \text{ kgf.m}, 7.2 \sim 8.7 \text{ lb-ft})$ 

#### **CIRCUIT DIAGRAM**

#### [Circuit Diagram]

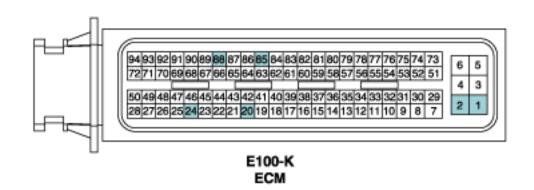
### ETC Module (E122) ECM (E100-K) 2 20 - Sensor Power (+3.3V) 24 - TPS 1 Signal TPS 1 1 85 - Sensor Ground 5 88 - TPS 2 Signal TPS 2 ETC Motor 3 1 - ETC Motor [+] Control М 6 2 - ETC Motor [-] Control

#### [Connection Information]

Terminal	Connected to	Function
1	ECM E100-K (85)	Sensor Ground
2	ECM E100-K (20)	Sensor Power (+5V)
3	ECM E100-K (1)	ETC Motor [+] Control
4	ECM E100-K (24)	TPS 1 Signal
5	ECM E100-K (88)	TPS 2 Signal
6	ECM E100-K (2)	ETC Motor [-] Control

#### [Harness Connector]





### **SPECIFICATION**

### [Throttle Position Sensor (TPS)]

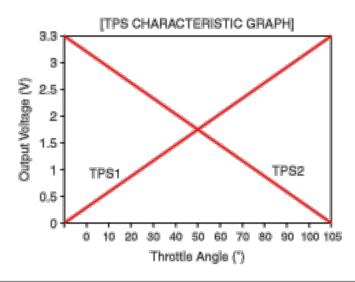
Throttle Angle (%)	Output Voltage(V) [Vref = 3.3V]	
Throttle Angle(°)	TPS1	TPS2
0	0	3.3
10	0.31	2.99
20	0.63	2.67
30	0.94	2.36
40	1.26	2.04
50	1.57	1.73
60	1.89	1.41
70	2.2	1.1
80	2.51	0.79
90	2.83	0.47
100	3.14	0.16
105	3.3	0

### [TPS 1]

ltem	Throttle Angle(°)	Output Voltage(V) [Vref = 3.3V]
C.T	6.3 ~ 14.7	0.20 ~ 0.46
W.O.T	93.45 ~ 101.85	2.94 ~ 3.20

### [TPS 2]

Item	Throttle Angle(°)	Output Voltage(V)
C.T	90.3 ~ 98.7	2.84 ~ 3.10
W.O.T	3.15 ~ 11.55	0.10 ~ 0.36



Item

### **FAIL-SAFE MODE**

Item	Fail-S	Safe
ETC Motor	Throttle valve stuck at 5°	
	TPS 1 fault	ECM looks at TPS2
TPS	TPS 2 fault	ECM looks at TPS1
	TPS 1,2 fault	Throttle valve stuck at 5°
	APS 1 fault	ECM looks at APS 2
APS	APS 2 fault	ECM looks at APS 1
	APS 1,2 fault	Throttle valve stuck at 5°

### NOTICE

When throttle value is stuck at  $5^{\circ}$ , engine speed is limited at below 1,500rpm and vehicle speed at maximum 40 ~ 50 km/h (25 ~ 31 mph)

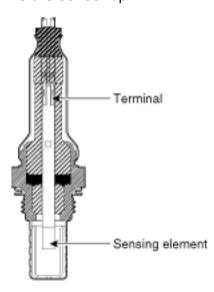
2016 > G 1.2 MPI > G 1.2 MPI > Engine Control / Fuel System > Engine Control System > Heated Oxygen Sensor (HO2S) > Description and Operation

### **DESCRIPTION**

Heated Oxygen Sensor (HO2S) consists of zirconium and alumina and is installed on upstream and downstream of the Warm up Catalytic Converter (WCC).

After it compares oxygen consistency of the atmosphere with the exhaust gas, it transfers the corresponding voltage signal to the ECM. When A/F ratio is rich or lean, it generates approximately +1V or 0V respectively.

In order that this sensor normally operates, the temperature of the sensor tip must be higher than predetermined temperature. So it has a heater which is controlled by the ECM duty signal. When the exhaust gas temperature is lower than the specified value, the heater warms the sensor tip.



#### **INSPECTION**

1. Check signal waveform of HO2S using a GDS.

Specification: Refer to "Waveform"

- 2. Turn the ignition switch OFF.
- 3. Disconnect the HO2S connector.
- 4. Measure resistance between HO2S heater terminals 3 and 4.
- 5. Check that the resistance is within the specification.

Specification: Refer to "Specification"

#### **REMOVAL**

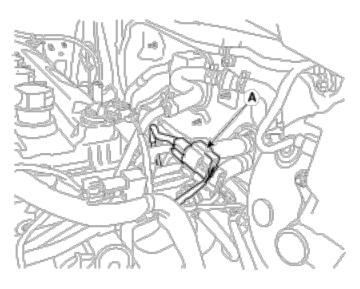
#### [Bank 1 / Sensor 1]

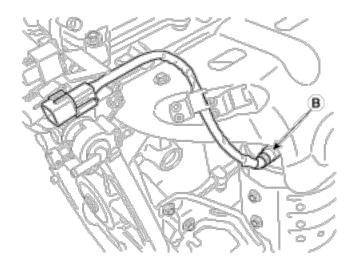
- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- 2. Disconnect the connector (A), and then remove the sensor (B).

#### NOTICE

Note that the SST (Part No.: 09392-1Y100 or 09392-2H100) is useful when removing the heated oxygen sensor.

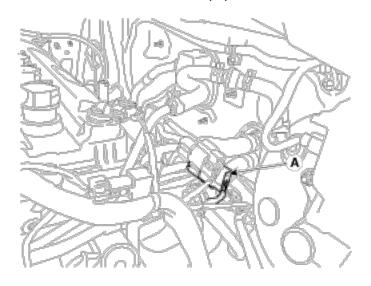




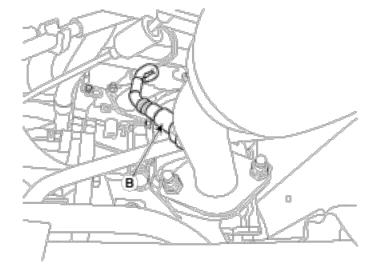


### [Bank 1 / Sensor 2]

- 3. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- 4. Disconnect the connector (A).



5. Remove the sensor (B) after lifting the vehicle.



#### **INSTALLATION**

# **▲** CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

### **▲** CAUTION

• DON'T use a cleaner, spray, or grease to sensing element and connector of the sensor because oil

component in them may malfunction the sensor performance.

- Sensor and its wiring may be damaged in case of contacting with the exhaust system (Exhaust Manifold, Catalytic Converter, and so on).
- 1. Install in the reverse order of removal.

Heated oxygen sensor installation:

39.2 ~ 49.1 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.2 lb-ft)

#### **CIRCUIT DIAGRAM**

#### [Circuit Diagram]

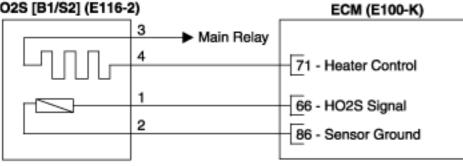
#### HO2S [B1/S1] (E116-1) ECM (E100-K) Main Relay 4 7 - Heater Control 87 - HO2S Signal 2 86 - Sensor Ground

#### [Conection Information]

#### HO2S [B1/S1] (E116-1)

Terminal	Conected to	Function
1	ECM E100-K (87)	HO2S [B1/S1] Signal
2	ECM E100-K (86)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM E100-K (7)	Heater Control

### HO2S [B1/S2] (E116-2)



#### HO2S [B1/S2] (E116-2)

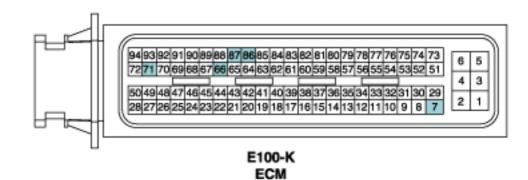
Terminal	Conected to	Function
1	ECM E100-K (66)	HO2S [B1/S2] Signal
2	ECM E100-K (86)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM E100-K (71)	Heater Control

#### [Harness Connector]









### **SPECIFICATION**

### [Bank 1 / Sensor 1]

A/F Ratio (λ)	Output Voltage(V)
Rich	0.6 ~ 1.0
Lean	0 ~ 0.4

ltem	Specification
Heater Resistance(Ω)	Approx. 9.0 [20°C (68°F)]

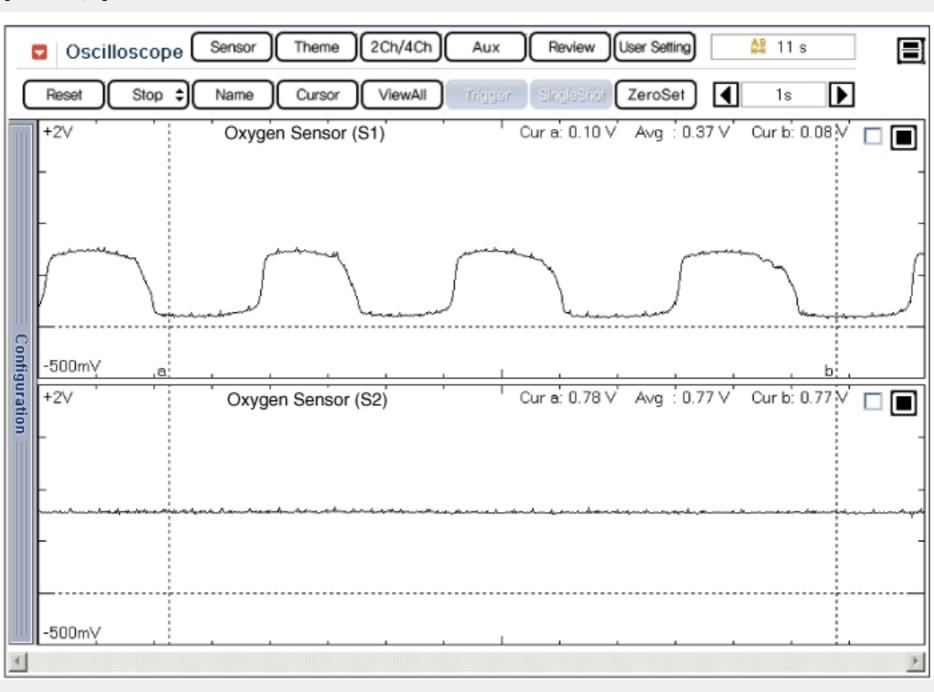
### [Bank 1 / Sensor 2]

A/F Ratio (λ)	Output Voltage(V)
Rich	0.6 ~ 1.0
Lean	0 ~ 0.4

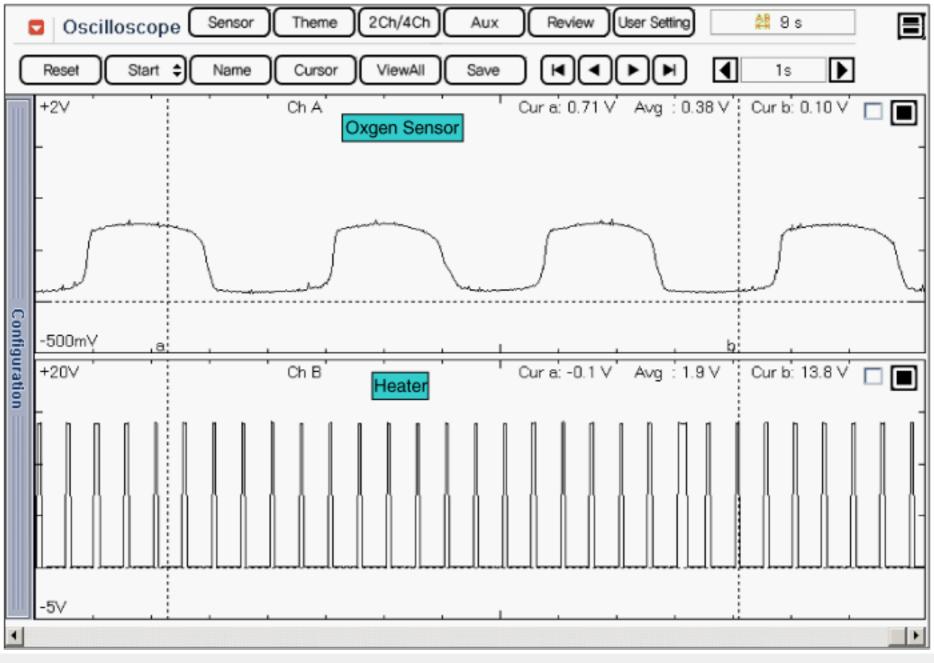
ltem	Specification
Heater Resistance(Ω)	Approx. 9.0 [20°C (68°F)]

#### **SIGNAL WAVEFORM**

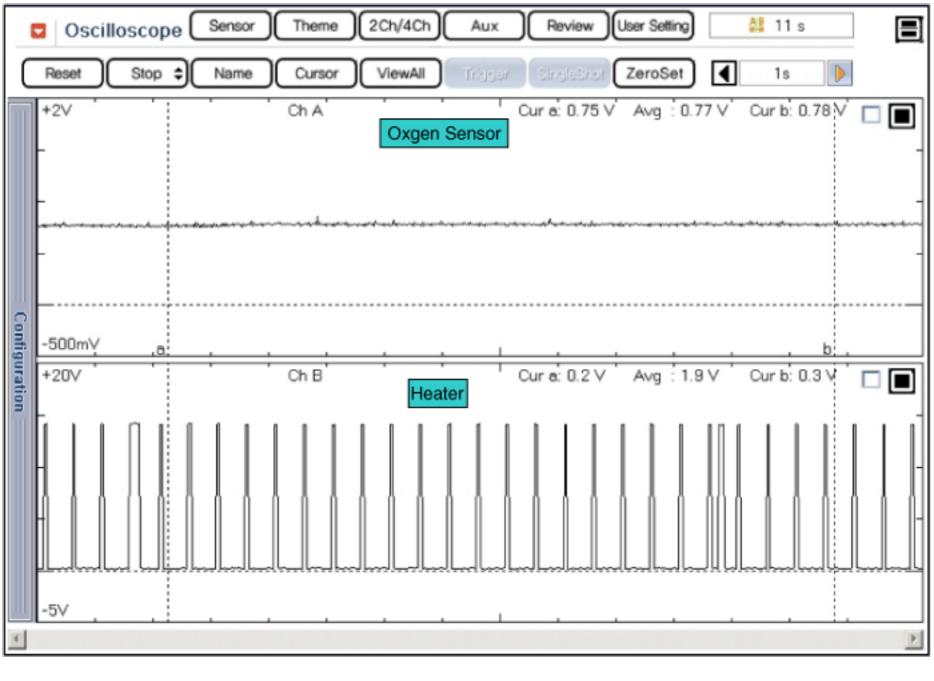
### [Sensor 1, 2]



[Bank 1 / Sensor 1]



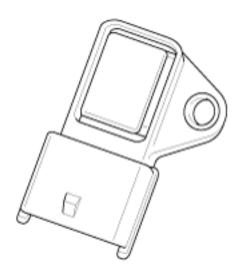
[Bank 1 / Sensor 2]



2016 > G 1.2 MPI > G 1.2 MPI > Engine Control / Fuel System > Engine Control System Temperature Sensor (IATS) > Description and Operation

### **DESCRIPTION**

Intake Air Temperature Sensor (IATS) is included inside Manifold Absolute Pressure Sensor and detects the intake air temperature. To calculate precise air quantity, correction of the air temperature is needed because air density varies according to the temperature. So the ECM uses not only MAPS signal but also IATS signal. This sensor has a Negative Temperature Coefficient (NTC) and its resistance is in inverse proportion to the temperature.



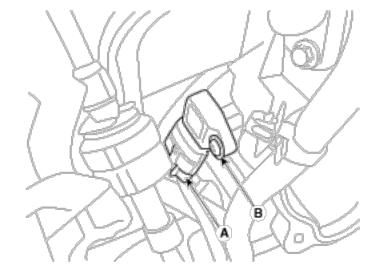
#### **INSPECTION**

- 1. Turn ignition switch OFF.
- 2. Disconnect IATS connector.
- 3. Measure resistance between IATS terminals 3 and 4.
- 4. Check that the resistance is within the specification.

Specification: Refer to "Specification"

#### **REMOVAL**

- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- Remove the air intake hose.(Refer to Engine Mechanical System "Intake And Exhaust System")
- Remove the ETC module.
   (Refer to Engine Control System "ETC system")
- 4. Disconnect the manifold absolute pressure sensor connector (A).
- 5. Remove the installation screw (B), and then remove the sensor from the surge tank.



#### **INSTALLATION**

### ▲ CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

### **▲** CAUTION

- Insert the sensor in the installation hole and be careful not to damage when installation.
- 1. Install in the reverse order of removal.

# Electronic throttle body Installation screw: 6.4 ~ 8.3 N.m (0.65 ~ 0.85 kgf.m, 4.7 ~ 6.1 lb-ft)

#### **CIRCUIT DIAGRAM**

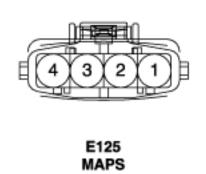
#### [Circuit Diagram]

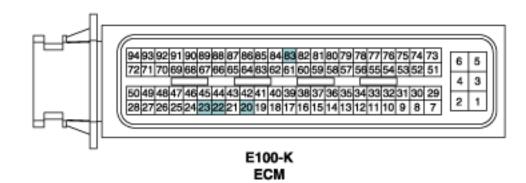
#### MAPS (E125) ECM (E100-K) 83 - Sensor Ground 2 42 - Sensor Power (+5V) 1 23 - MAPS Signal 3 22 - IATS Signal

#### [Conection Information]

Terminal	Conected to	Function
1	ECM E100-K (23)	MAPS Signal
2	ECM E100-K (42)	Sensor Power (+5V)
3	ECM E100-K (22)	IATS Signal
4	ECM E100-K (83)	Sensor Ground

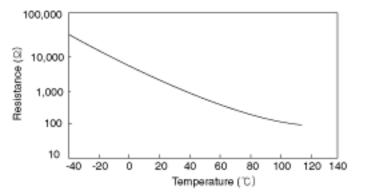
#### [Harness Connector]



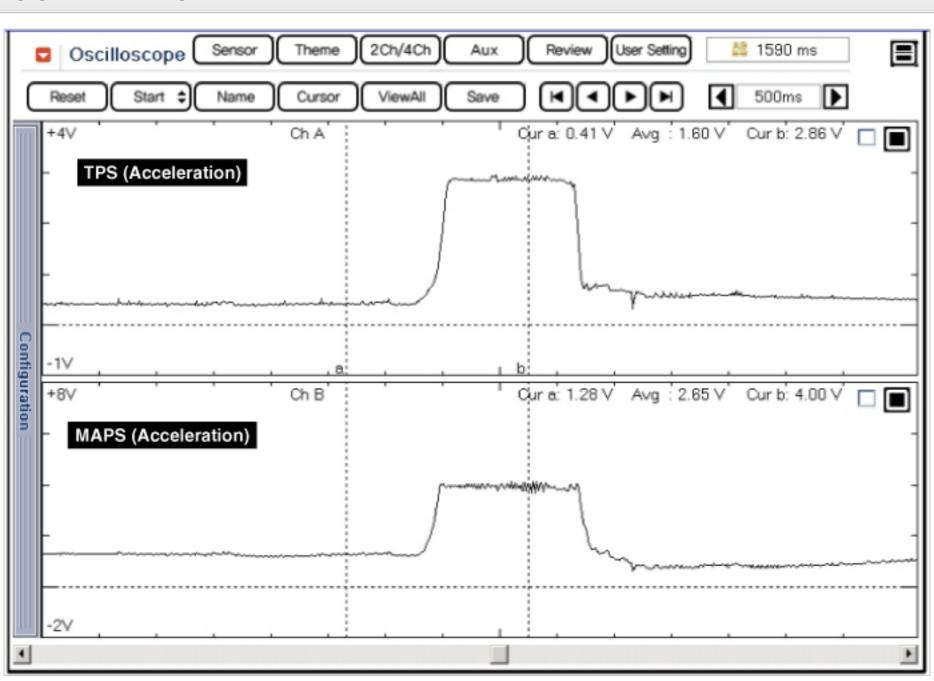


### **SPECIFICATION**

Temperature [°C(°F)]	Resistance(kΩ)
-40 (-40)	40.93 ~ 48.35
-30 (-22)	23.43 ~ 27.34
-20 (-4)	13.89 ~ 16.03
-10 (14)	8.50 ~ 9.71
0 (32)	5.38 ~ 6.09
10 (50)	3.48 ~ 3.90
20 (68)	2.31 ~ 2.57
25 (77)	1.90 ~ 2.10
30 (86)	1.56 ~ 1.74
40 (104)	1.08 ~ 1.21
60 (140)	0.54 ~ 0.62
80 (176)	0.29 ~ 0.34

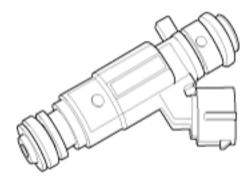


#### **SIGNAL WAVEFORM**



### **DESCRIPTION**

Based on information from various sensors, the ECM can calculate the fuel amount to be injected. The fuel injector is a solenoid-operated valve and the fuel injection amount is controlled by length of injection time. The ECM controls each injector by grounding the control circuit. When the ECM energizes the injector by grounding the control circuit, the circuit voltage should be low (theoretically 0V) and the fuel is injected. When the ECM de-energizes the injector by opening control circuit, the fuel injector is closed and circuit voltage should momentarily peak.



## Engine Control System > Injector >

#### **INSPECTION**

- 1. Turn ignition switch OFF.
- 2. Disconnect injector connector.
- 3. Measure resistance between injector terminals 1 and 2.
- 4. Check that the resistance is within the specification.

Specification: Refer to "Specification"

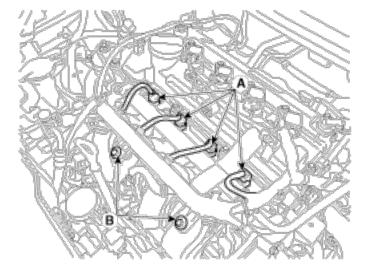
#### **REMOVAL**

- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- Release the residual pressure in fuel line.
   (Refer to Fuel Delivery System "Release Residual Pressure in Fuel Line")

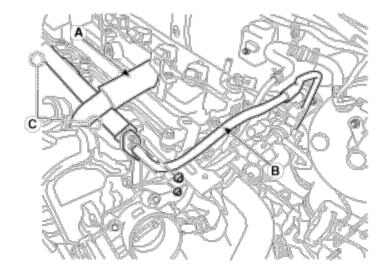
### **▲** CAUTION

When removing the fuel pump relay, a Diagnostic Trouble Code (DTC) may occur. Delete the code with the GDS after completion of "Release Residual Pressure in Fuel Line" work.

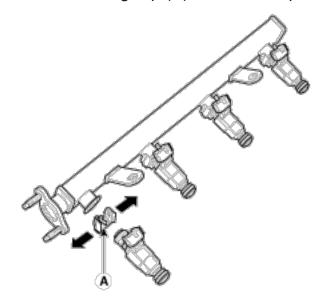
- 3. Disconnect the injector connector (A).
- 4. Remove the wiring harness bracket installation bolt (B).



- 5. Remove the PCV hose (A).
- 6. Remove the installation nut, and then disconnect the fuel feed tube (B).
- 7. Remove the installation bolt (C), and then remove the delivery pipe & injector assembly from the engine.



8. Remove the fixing clip (A), and then separate the injector from the delivery pipe.



#### **INSTALLATION**

### **▲** CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting

### **▲** CAUTION

• Apply the engine oil to the injector O-ring.

### **▲** CAUTION

- Inspect the injector O-ring when installing.
- 1. Install in the reverse order of removal.

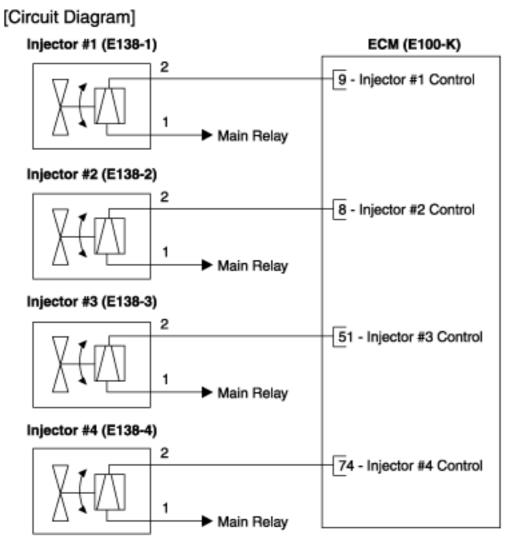
#### **Delivery pipe installation bolt:**

7.8 ~ 11.8 N.m (1.9 ~ 2.4 kgf.m, 5.8 ~ 8.7 lb-ft)

**Delivery pipe installation nut (**← **Fuel feed tube)**:

18.6 ~ 23.5 N.m (0.4 ~ 0.6 kgf.m, 13.7 ~ 17.4 lb-ft)

#### **CIRCUIT DIAGRAM**



#### [Conection Information]

#### Injector #1 (E138-1)

Terminal	Conected to	Function
1	Main Relay	Battery Power (B+)
2	ECM E100-K (9)	Injector #1 Control

#### Injector #2 (E138-2)

Terminal	Conected to	Function
1	Main Relay	Battery Power (B+)
2	ECM E100-K (8)	Injector #2 Control

#### Injector #3 (E138-3)

Terminal	Conected to	Function
1	Main Relay	Battery Power (B+)
2	ECM E100-K (51)	Injector #3 Control

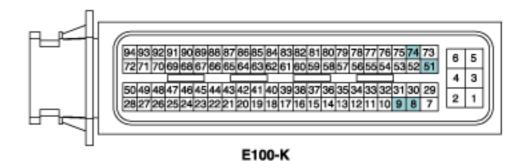
#### Injector #4 (E138-4)

Terminal	Conected to	Function
1	Main Relay	Battery Power (B+)
2	ECM E100-K (74)	Injector #4 Control

#### [Harness Connector]



E138-1,2,3,4 Injector #1,2,3,4



ECM

2016 > G 1.2 MPI > G 1.2 MPI > Engine Control / Fuel System > Engine Control System > Injector > Specifications

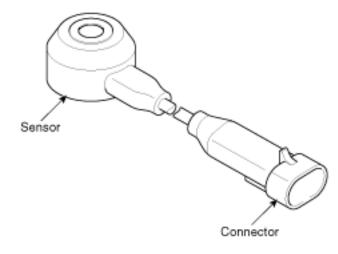
### **SPECIFICATION**

ltem	Specification
Coil Resistance (Ω)	13.8 ~ 15.2 [20°C(68°F)]

### **DESCRIPTION**

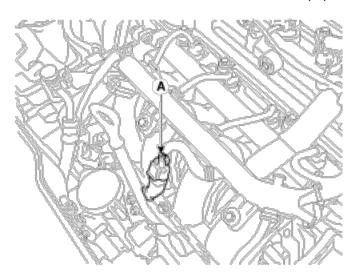
Knocking is a phenomenon characterized by undesirable vibration and noise and can cause engine damage. Knock Sensor (KS) is installed on the cylinder block and senses engine knocking.

When knocking occurs, the vibration from the cylinder block is applied as pressure to the piezoelectric element. At this time, this sensor transfers the voltage signal higher than the specified value to the ECM and the ECM retards the ignition timing. If the knocking disappears after retarding the ignition timing, the ECM will advance the ignition timing. This sequential control can improve engine power, torque and fuel economy.

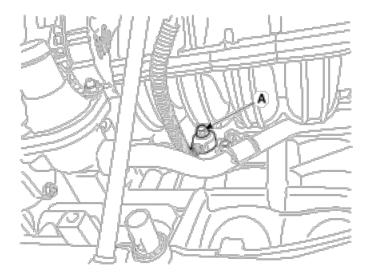


### **REMOVAL**

- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- 2. Disconnect the knock sensor connector (A).



- Remove the starter.
   (Refer to Engine Electrical System "Starter")
- 4. Remove the installation bolt (A), and then remove the sensor from the cylinder block.



#### **INSTALLATION**

### **▲** CAUTION

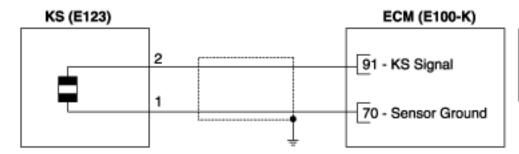
- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.
- 1. Install in the reverse order of removal.

#### **Knock sensor installation bolt:**

18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)

### **CIRCUIT DIAGRAM**

#### [Circuit Diagram]

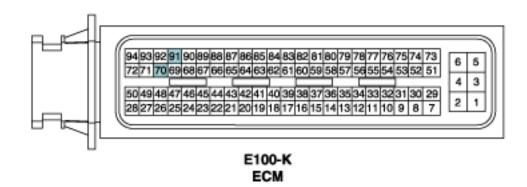


#### [Conection Information]

Terminal	Conected to	Function
1	ECM E100-K (70)	Sensor Ground
2	ECM E100-K (91)	Knock Sensor Signal

#### [Harness Connector]





2016 > G 1.2 MPI > G 1.2 MPI > Engine Control / Fuel System > Engine Control System > Knock Sensor (KS) > Specifications

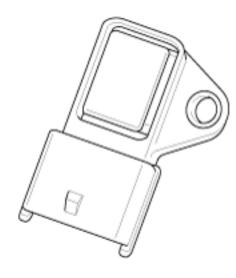
### **SPECIFICATION**

Item	Specification
Capacitance(pF)	950 ~ 1,350
Resistance (MΩ)	4.87

#### **DESCRIPTION**

Manifold Absolute Pressure Sensor (MAPS) is a speed-density type sensor and is installed on the surge tank. It senses absolute pressure of the surge tank and transfers the analog signal proportional to the pressure to the ECM. By using this signal, the ECM calculates the intake air quantity and engine speed.

The MAPS consists of a piezo-electric element and a hybrid IC amplifying the element output signal. The element is silicon diaphragm type and adapts pressure sensitive variable resistor effect of semi-conductor. Because 100% vacuum and the manifold pressure apply to both sides of the sensor respectively, this sensor can output analog signal by using the silicon variation proportional to pressure change.



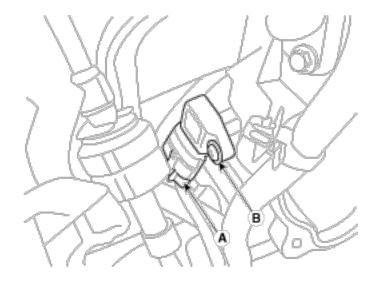
#### **INSPECTION**

- 1. Connect a GDS on Data Link Connector (DLC).
- 2. Check MAPS output voltage at idle and IG ON.

Condition	Output Voltage (V)
IG ON	3.9 ~ 4.1
Idle	0.8 ~ 1.6

#### **REMOVAL**

- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- Remove the air intake hose.
   (Refer to Engine Mechanical System "Intake And Exhaust System")
- 3. Remove the ETC module. (Refer to Engine Control System "ETC system")
- 4. Disconnect the manifold absolute pressure sensor connector (A).
- 5. Remove the installation screw (B), and then remove the sensor from the surge tank.



#### **INSTALLATION**

# **▲** CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

# **▲** CAUTION

Insert the sensor in the installation hole and be careful not to damage when installation.

1. Install in the reverse order of removal. Electronic throttle body Installation screw: 6.4 ~ 8.3 N.m (0.65 ~ 0.85 kgf.m, 4.7 ~ 6.1 lb-ft)

#### **CIRCUIT DIAGRAM**

#### [Circuit Diagram]

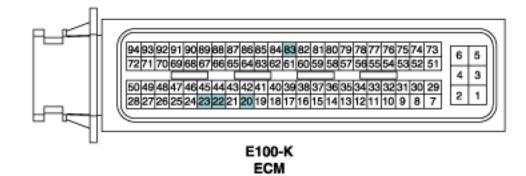
#### MAPS (E125) ECM (E100-K) 83 - Sensor Ground 2 42 - Sensor Power (+5V) 1 23 - MAPS Signal 3 22 - IATS Signal

#### [Conection Information]

Terminal	Conected to	Function
1	ECM E100-K (23)	MAPS Signal
2	ECM E100-K (42)	Sensor Power (+5V)
3	ECM E100-K (22)	IATS Signal
4	ECM E100-K (83)	Sensor Ground

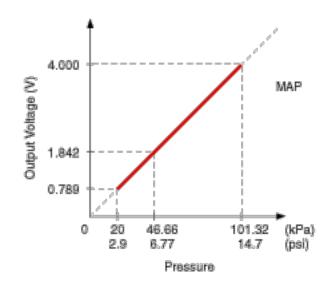
#### [Harness Connector]



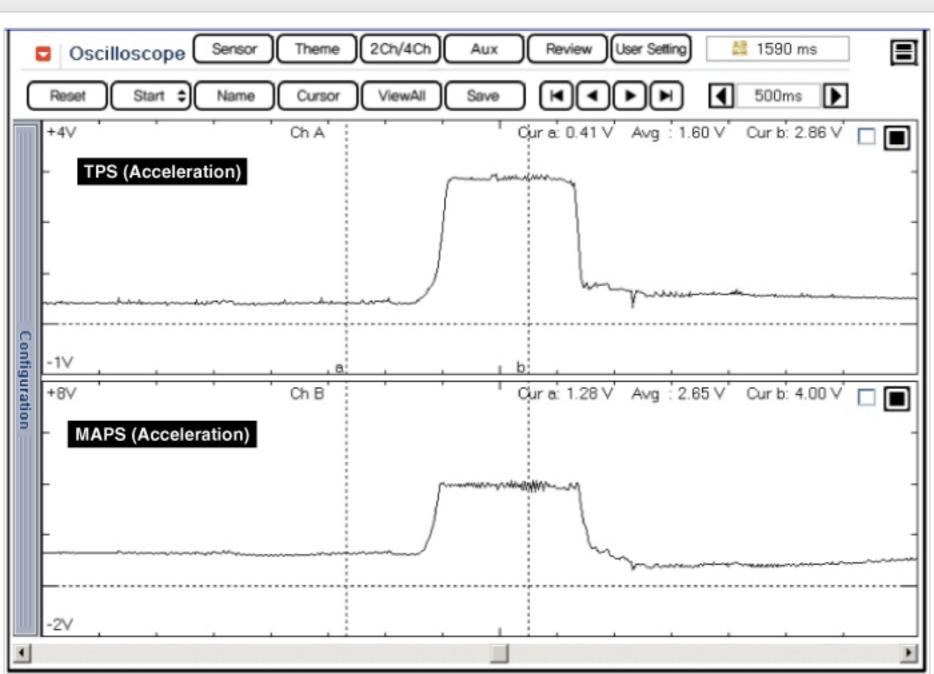


# **SPECIFICATION**

Pressure [kPa (kg/cm², psi)]	Output Voltage (V)
20.0 (0.20, 2.9)	0.79
46.7 (0.47, 6.77)	1.84
101.32 (1.03, 14.7)	4.0



#### **SIGNAL WAVEFORM**

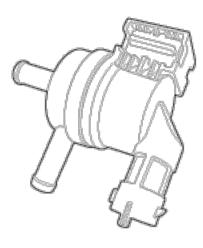


2016 > G 1.2 MPI > G 1.2 MPI > Engine Control / Fuel System > Engine Control System > Purge Control Solenoid Valve (PCSV) > Description and Operation

# **DESCRIPTION**

Purge Control Solenoid Valve (PCSV) is a solenoid valve and is installed on the surge tank and controls the passage between the canister and the intake manifold.

The evaporative gases gathered in the canister are delivered to the intake manifold when the PCSV is open by ECM control signal.



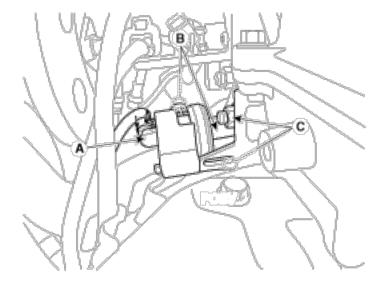
#### **INSPECTION**

- 1. Turn ignition switch OFF.
- 2. Disconnect PCSV connector.
- 3. Measure resistance between PCSV terminals 1 and 2.
- 4. Check that the resistance is within the specification.

Specification: Refer to "Specification"

#### **REMOVAL**

- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- 2. Remove the air duct. (Refer to Engine Mechanical System - "Intake and Exhaust System")
- 3. Disconnect the purge control solenoid valve connector (A).
- 4. Disconnect the vapor hoses (B) from the purge control solenoid valve.
- 5. Remove the bracket installation nuts (C), and then remove the purge control solenoid valve.



#### INSTALLATION

# **▲** CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

# **▲** CAUTION

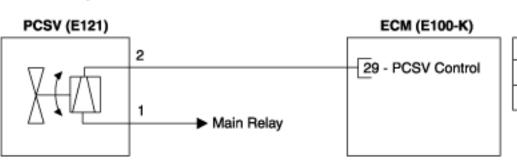
- Be careful of foreign material not to flow into the valve.
- 1. Install in the reverse order of removal.

# Purge control solenoid valve bracket installation bolt: $9.8 \sim 11.8 \text{ N.m} (1.0 \sim 1.2 \text{ kgf.m}, 7.2 \sim 8.7 \text{ lb-ft})$

#### **CIRCUIT DIAGRAM**

[Circuit Diagram]

#### [Conection Information]

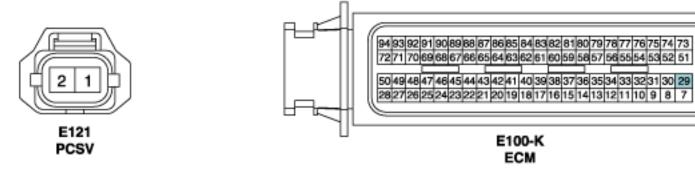


Terminal	Conected to	Function
1	Main Relay	Battery Power (B+)
2	ECM E100-K (29)	PCSV Control

6 5 4 3

2 1



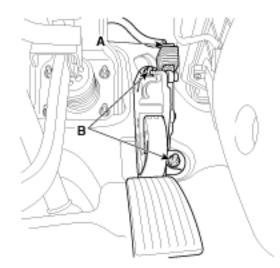


2016 > G 1.2 MPI > G 1.2 MPI > Engine Control / Fuel System > Engine Control System > Purge Control Solenoid Valve (PCSV) > Specifications

# **SPECIFICATION**

ltem	Specification	
Coil Resistance (Ω)	14.0 ~ 18.0 [20°C (68°F)]	

- 1. Turn the ignition switch OFF and disconnect the negative (-) battery cable.
- 2. Disconnect the accelerator position sensor connector (A).
- 3. Remove the installation nuts (B), and then remove the accelerator pedal module.



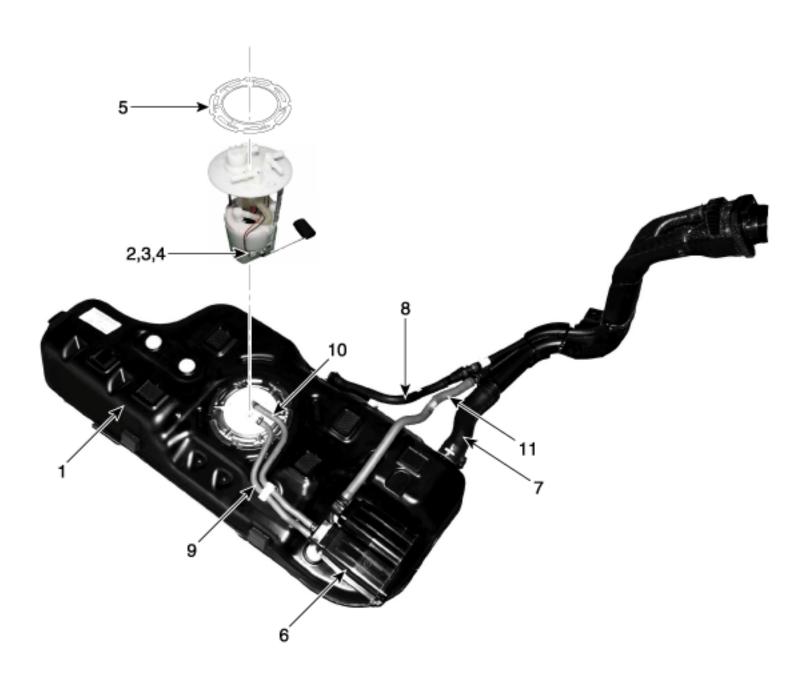
### **INSTALLATION**

1. Install in the reverse order of removal.

Accelerator pedal module installation nut:

9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)

# **COMPONENT LOCATION**



- 1. Fuel Tank
- 2. Fuel Pump
- 3. Fuel Fiter
- 4. Fuel Pressure Regulator
- 5. Fuel Pump Plate Cover
- 6. Canister

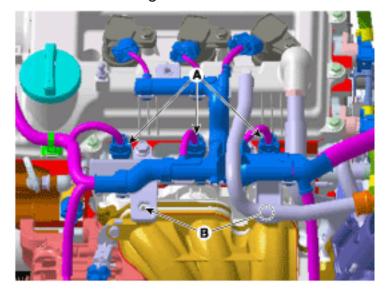
- 7. Fuel Filler Hose
- 8. Leveling Hose
- 9. Vapor Hose (Canister → Intake Manifold)
- 10. Vapor Hose (Canister ↔ Fuel Tank)
- 11. Vapor Hose (Canister ↔ Atmosphere)

- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- 2. Release the residual pressure in fuel line.
  (Refer to Fuel Delivery System "Release Residual Pressure in Fuel Line")

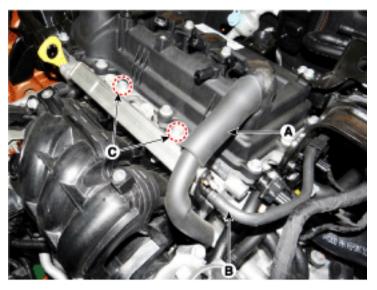
# **▲** CAUTION

When removing the fuel pump relay, a Diagnostic Trouble Code (DTC) may occur. Delete the code with the GDS after completion of "Release Residual Pressure in Fuel Line" work.

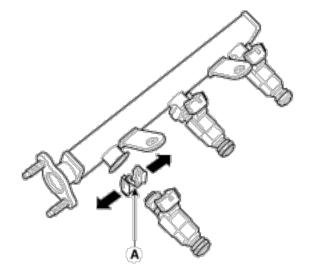
- 3. Disconnect the injector connector (A).
- 4. Remove the wiring harness bracket installation bolt (B).



- 5. Remove the PCV hose (A).
- 6. Remove the installation nut, and then disconnect the fuel feed tube (B).
- 7. Remove the installation bolt (C), and then remove the delivery pipe & injector assembly from the engine.



8. Remove the fixing clip (A), and then separate the injector from the delivery pipe.



#### **INSTALLATION**

# **▲** CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting

# **▲** CAUTION

• Apply the engine oil to the injector O-ring.

# **▲** CAUTION

- Inspect the injector O-ring when installing.
- 1. Install in the reverse order of removal.

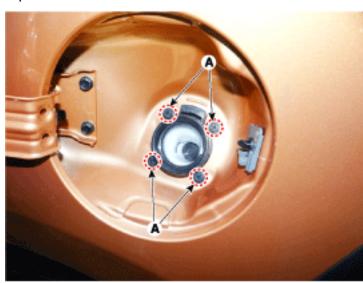
#### **Delivery pipe installation bolt:**

7.8 ~ 11.8 N.m (1.9 ~ 2.4 kgf.m, 5.8 ~ 8.7 lb-ft)

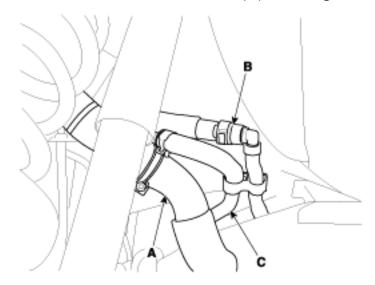
**Delivery pipe installation nut (**← **Fuel feed tube)**:

18.6 ~ 23.5 N.m (0.4 ~ 0.6 kgf.m, 13.7 ~ 17.4 lb-ft)

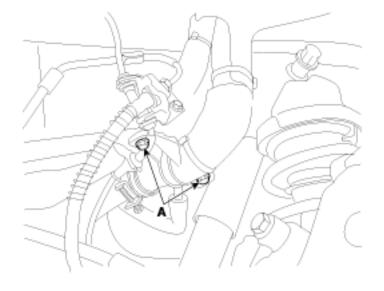
1. Open the fuel filler door and unfasten the filler-neck assembly mounting bolts (A).



- 2. Lift the vehicle.
- 3. Remove the rear-LH wheel and tire, and the inner wheel house.
- 4. Disconnect the fuel filler hose (A), leveling hose (B) and the ventilation hose (C).



5. Remove the bracket mounting bolt (A) and remove the filler-neck assembly.



#### **INSTALLATION**

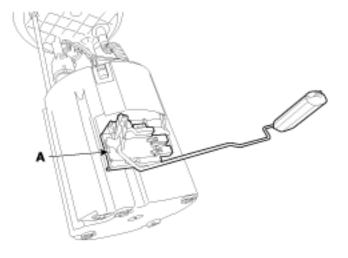
1. Install in the reverse order of removal.

# Filler-neck assembly bracket installation bolt: $7.8 \sim 11.8 \text{ N.m} (0.8 \sim 1.2 \text{ kgf.m}, 5.8 \sim 8.7 \text{ lb-ft})$

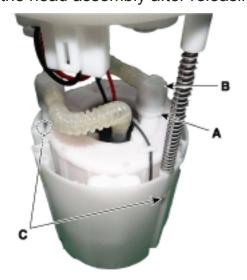
- Remove the fuel pump.
   (Refer to Fuel Delivery System "Fuel Pump")
- 2. Disconnect the electric pump wiring connector (A) and the fuel sender connector (B).



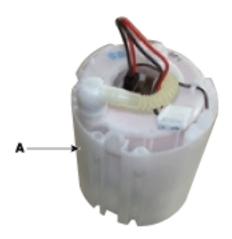
3. Remove the fuel sender (A) after releasing the fix hook.



- 4. Remove the fixing clip (A), and then disconnect the fuel feed tube quick-connector (B).
- 5. Remove the head assembly after releasing the fixing hooks (C).



6. Remove the reservior-cup (A) after releasing the fixing hooks.

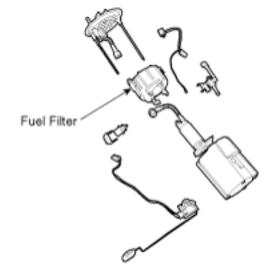


- 7. Disconnect the ground cable (A).
- 8. Remove the cap (B), and then remove the assist pump (C) and the fuel pressure regulator (D).



9. Separate the electric pump motor from the fuel filter after releasing the fixing hooks (A).





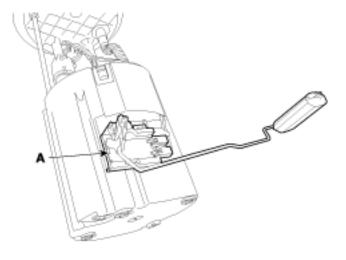
# **INSTALLATION**

1. Install in the reverse order of removal.

- Remove the fuel pump.
   (Refer to Fuel Delivery System "Fuel Pump")
- 2. Disconnect the electric pump wiring connector (A) and the fuel sender connector (B).



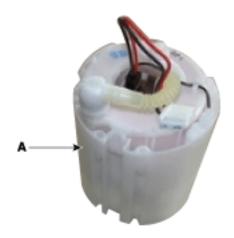
3. Remove the fuel sender (A) after releasing the fix hook.



- 4. Remove the fixing clip (A), and then disconnect the fuel feed tube quick-connector (B).
- 5. Remove the head assembly after releasing the fixing hooks (C).



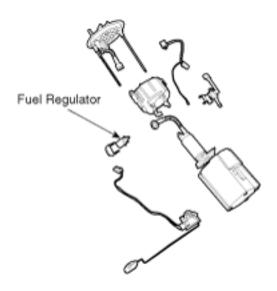
6. Remove the reservior-cup (A) after releasing the fixing hooks.



- 7. Disconnect the ground cable (A).
- 8. Remove the cap (B), and then remove the assist pump (C) and the fuel pressure regulator (D).





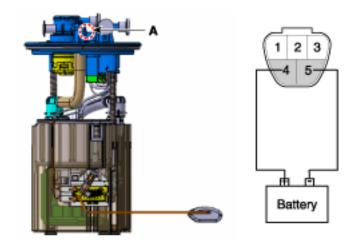




#### **INSPECTION**

# [Fuel Pump]

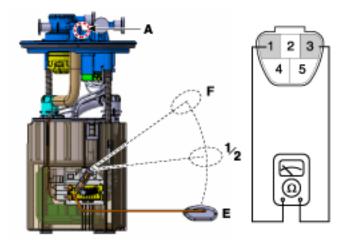
- 1. Turn ignition switch OFF and disconnect the negative (-)battery cable.
- 2. Remove the fuel pump assembly.
- 3. Check motor operation by fuel pump connector (A) connecting power(No.4) and ground(No.5)



Pin No.	Description
1	Fuel sender signal
2	-
3	Fuel sender ground
4	Fuel pump (+)
5	Fuel pump ground

#### [Fuel Sender]

- 1. Turn ignition switch OFF and disconnect the negative (-)battery cable.
- 2. Remove the fuel pump assembly.
- 3. Using an ohmmeter, measure the resistance between terminals 1 and 3 of sender connector (A) at each float level.



Pin No.	Description
1	Fuel sender signal

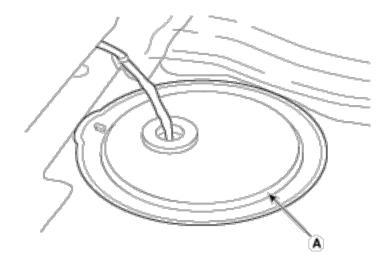
2	-
3	Fuel sender ground
4	Fuel pump (+)
5	Fuel pump ground

4. Also check that the resistance changes smoothly when the float is moved from "E" to "F".

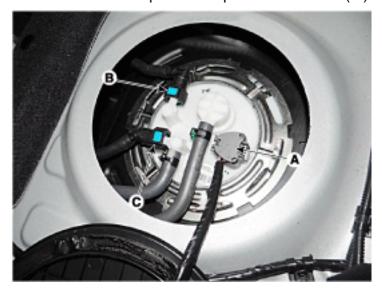
Position	Resistance (Ω)
E	198 ~ 202
1/2	97.1 ~ 101.1
F	6 ~ 10

# **REMOVAL**

- Release the residual pressure in the fuel line.
   (Refer to Fuel Delivery System "Release Pressure in Fuel Line")
- Remove the rear seat cushion. (Refer to Body - "Rear Seat Assembly")
- 3. Open the service cover (A).



- 4. Disconnect the fuel pump connector (A).
- 5. Disconnect the fuel feed tube quick-connector (B).
- 6. Disconncet the vapor tube quick-connector (C).



- 7. Disconnect the vapor hose (A).
- 8. Remove the plate cover (B).



# **INSTALLATION**

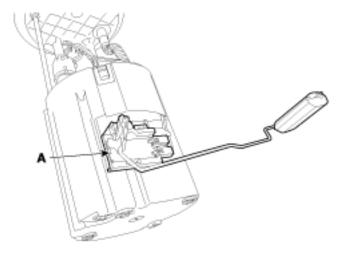
1. Install in the reverse order of removal.

Fuel pump plate cover installation nut: 100 ~ 300 N.m (10.2 ~ 30.6 kgf.m, 73.8 ~ 221.3 lb-ft)

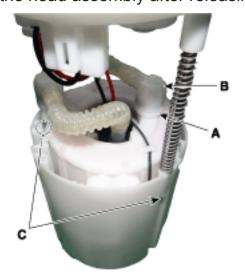
- Remove the fuel pump.
   (Refer to Fuel Delivery System "Fuel Pump")
- 2. Disconnect the electric pump wiring connector (A) and the fuel sender connector (B).



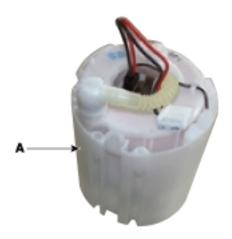
3. Remove the fuel sender (A) after releasing the fix hook.



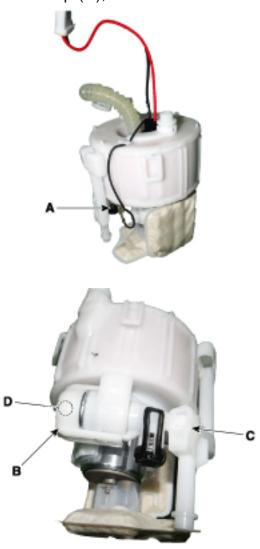
- 4. Remove the fixing clip (A), and then disconnect the fuel feed tube quick-connector (B).
- 5. Remove the head assembly after releasing the fixing hooks (C).



6. Remove the reservior-cup (A) after releasing the fixing hooks.

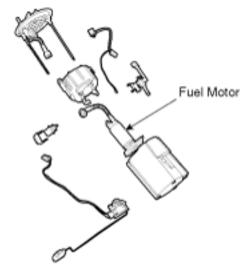


- 7. Disconnect the ground cable (A).
- 8. Remove the cap (B), and then remove the assist pump (C) and the fuel pressure regulator (D).



9. Separate the electric pump motor from the fuel filter after releasing the fixing hooks (A).





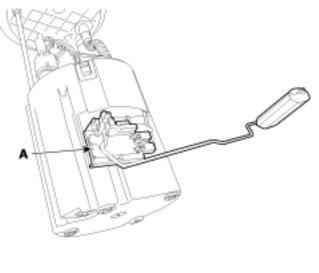
# **INSTALLATION**

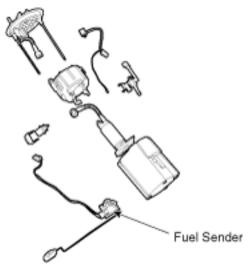
1. Install in the reverse order of removal.

- Remove the fuel pump.
   (Refer to Fuel Delivery System "Fuel Pump")
- 2. Disconnect the fuel sender connector (A).



3. Remove the fuel sender (A) after releasing the fix hook.

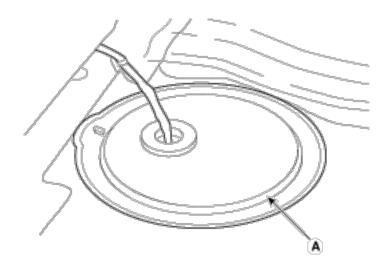




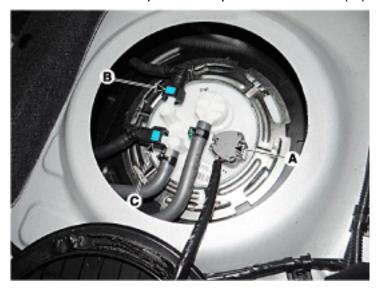
# **INSTALLATION**

1. Install in the reverse order of removal.

- Release the residual pressure in the fuel line.
   (Refer to Fuel Delivery System "Release Pressure in Fuel Line")
- Remove the rear seat cushion. (Refer to Body - "Rear Seat Assembly")
- 3. Open the service cover (A).



- 4. Disconnect the fuel pump connector (A).
- 5. Disconnect the fuel feed tube quick-connector (B).
- 6. Disconnect the vapor tube quick-connector (C).



- 7. Lift the vehicle and support the fuel tank with a jack.
- 8. Remove the center muffler. (Refer to Engine Mechanical System "Intake And Exhaust System")
- 9. Disconnect the fuel filler hose (A), the leveling hose (B) and the vapor hose (C).



10. Remove the brake line bracket mounting bolts (A).



- 11. Remove the fuel tank mounting nuts (A).
- 12. Support the fuel tank with a jack, and then remove the fuel tank (B).



# **INSTALLATION**

1. Install in the reverse order of removal.

Fuel tank installation nut:

 $39.2 \sim 53.9 \text{ N.m} (4.0 \sim 5.5 \text{ kgf.m}, 28.9 \sim 39.8 \text{ lb-ft})$ 

#### **FUEL PRESSURE TEST**

1. Release the residual pressure in fuel line (Refer to "Release Residual Pressure in Fuel Line" in this group).

# **▲** CAUTION

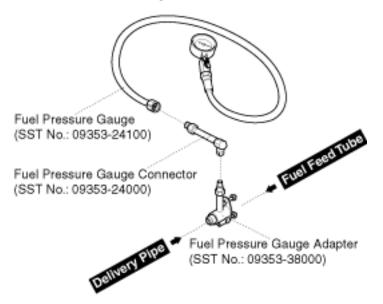
When removing the fuel pump relay, the Diagnostic Trouble Code (DTC) will be occurred. Therefore delete the code with the GDS after "Release Residual Pressure in Fuel Line" work.

- 2. Install the Special Service Tool (SST).
  - (1) Disconnect the fuel feed tube from the delivery pipe.

# **▲** CAUTION

There may be some residual pressure even after "Release Residual Pressure in Fuel Line" work, so cover the hose connection with a shop towel to prevent residual fuel from spilling out before disconnecting any fuel connection.

(2) Install the special service tool for measuring the fuel pressure in between the fuel feed tube and the fuel delivery pipe (Refer to the figure below).



- 3. Inspect fuel leakage on connections among the fuel feed tube, the delivery pipe, and the SST components with IG ON.
- 4. Measure Fuel Pressure
  - (1) Start the engine and measure the fuel pressure at idle.

#### **Fuel Pressure:**

 $330 \sim 370 \text{ kpa} (3.37 \sim 3.77 \text{ kgf/cm}^2, 47.9 \sim 53.7 \text{ psi})$ 

### NOTICE

If the fuel pressure differs from the standard value, repair or replace the related part (Refer to the table below).

Fuel Pressure	Cause	Related Part
	Fuel filter clogged	Fuel Filter

Too Low Fuel leakage	Fuel Pressure Regulator	
Too High	Fuel pressure regulator valve stuck	Fuel Pressure Regulator

(2) Stop the engine, and then check for the change in the fuel pressure gauge reading.

Standard Value: The gauge reading should hold for about 5 minutes after the engine stops

#### NOTICE

If the gauge reading should not be held, repair or replace the related part (Refer to the table below).

Fuel Pressure (After Engine Stops)	Cause	Related Part
Fuel Pressure Drops Slowly	Leakage on injector	Injector
Fuel Pressure Drops Immediately	Check valve of fuel pump open stuck	Fuel Pump

- (3) Turn the ignition switch OFF.
- 5. Release the residual pressure in fuel line (Refer to "Release Residual Pressure in Fuel Line").

# **▲** CAUTION

When removing the fuel pump relay, the Diagnostic Trouble Code (DTC) will be occurred. Therefore delete the code with the GDS after "Release Residual Pressure in Fuel Line" work.

- 6. Test End
  - (1) Remove the Special Service Tool (SST) from the fuel feed tube ant the delivery pipe.
  - (2) Connect the fuel feed tube and the delivery pipe.

#### RELEASE RESIDUAL PRESSURE IN FUEL LINE

# **▲** CAUTION

There may be some residual pressure even after "Release Residual Pressure in Fuel Line" work, so cover the hose connection with a shop towel to prevent residual fuel from spilling out before disconnecting any fuel connection.

- 1. Turn the ignition switch OFF and disconnect the battery (-) cable.
- 2. Remove the fuel pump fuse (A).



# **▲** CAUTION

When removing the fuel pump fuse, a Diagnostic Trouble Code (DTC) may occur. Delete the code with the GDS after completion of "Release Residual Pressure in Fuel Line" work.

- 3. Connect the battery (-) cable.
- 4. Start the engine and let idle, and then turn the ignition switch OFF after the engine has stopped on its own.
- 5. Disconnect the battery (-) cable, and then install the fuel pump fuse (A).
- 6. Connect the battery (-) cable.
- 7. Delete the Diagnostic Trouble Code (DTC) related the fuel pump relay with the GDS.

# SPECIAL SERVICE TOOLS

Tool (Number and name)	Illustration	Application
09353-24100 Fuel Pressure Gauge		Measuring the fuel line pressure
09353-38000 Fuel Pressure Gauge Adapter		Connection between the delivery pipe and fuel feed line
09353-24000 Fuel Pressure Gauge Connector		Connection between Fuel Pressure Gauge (09353-24100) and Fuel Pressure Gauge Adapter (09353-38000)
09392-1Y100 Heated Oxygen Sensor Socket Wrench		Removal and installation of the heated oxygen sensor
09310-B9100 Fuel Pump Locking Ring Remover		Removal and installation of the fuel pump locking ring

# **SPECIFICATIONS**

# Fuel Delivery System

Items	Specification	
Fuel Tank	Capacity	43 lit. (11.4 U.S.gal., 45.4 U.S.qt, 37.8 lmp.qt.)
Fuel Filter (built in Fuel Pump Assembly)	Туре	Paper type
Fuel Pressure Regulator (built in Fuel Pump assembly)	Regulated Fuel Pressure	330 ~ 370 kpa (3.37 ~ 3.77 kgf/cm², 47.9 ~ 53.7 psi)
Fuel Pump	Туре	Electrical, in-tank type
	Driven by	Electric motor
Fuel Retrun System	Туре	Returnless

#### Sensors

Manifold Absolute Pressure Sensor (MAPS)

Pressure [kPa (kg/cm², psi)]	Output Voltage (V)
20.0 (0.20, 2.9)	0.79
46.7 (0.47, 6.77)	1.84
101.32 (1.03, 14.7)	4.0

Intake Air Temperature Sensor (IATS)

Temperature [°C(°F)]	Resistance (kΩ)
-40(-40)	40.93 ~ 48.35
-30(-22)	23.43 ~ 27.34
-20(-4)	13.89 ~ 16.03
-10(14)	8.50 ~ 9.71
0(32)	5.38 ~ 6.09
10(50)	3.48 ~ 3.90
20(68)	2.31 ~ 2.57
25(77)	1.90 ~ 2.10
30(86)	1.56 ~ 1.74
40(104)	1.08 ~ 1.21
60(140)	0.54 ~ 0.62
80(176)	0.29 ~ 0.34

Engine Coolant Temperature Sensor (ECTS)

## 

Temperature [°C(°F)]	Resistance (kΩ)
-40(-40)	48.14
-20(-4)	14.13 ~ 16.83
0(32)	5.79
20(68)	2.31 ~ 2.59
40(104)	1.15
60(140)	0.59
80(176)	0.32

Throttle Position Sensor (TPS) [integrated into ETC Module]

Throttle Angle(°)	Output Voltage(V) [Vref = 3.3V]	
	TPS1	TPS2
0	0	3.3
10	0.31	2.99
20	0.63	2.67
30	0.94	2.36
40	1.26	2.04
50	1.57	1.73
60	1.89	1.41
70	2.2	1.1
80	2.51	0.79
90	2.83	0.47
100	3.14	0.16
105	3.3	0

## [TPS 1]

Item	Throttle Angle(°)	Output Voltage(V) [Vref = 3.3V]
C.T	6.3 ~ 14.7	0.20 ~ 0.46
W.O.T	93.45 ~ 101.85	2.94 ~ 3.20

## [TPS 2]

Item	Throttle Angle(°)	Output Voltage(V)
C.T	90.3 ~ 98.7	2.84 ~ 3.10
W.O.T	3.15 ~ 11.55	0.10 ~ 0.36

Item	Sensor resistance (kΩ)
TPS	0.875 ~ 1.625 (20°C)

▶ Type: Zirconia (ZrO2) type▶ Specification

A/F Ratio	Output Voltage (V)
Rich	0.6 ~ 1.0
Lean	0 ~ 0.4

Item	Resistance (Ω)
Heater Resistance (Ω)	Approx. 9.0 (20°C)

Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]

A/F Ratio

Rich

ltem	Resistance (Ω)
Lean	0 ~ 0.4

**Output Voltage (V)** 

 $0.6 \sim 1.0$ 

Resistance (Ω)
Approx. 9.0 (20°C)

Camshaft Position Sensor (CMPS)

Type: Hall effect type

Knock Sensor (KS)

Type: Piezo-electricity typeSpecification

ltem	Specification
Capacitance (pF)	950 ~ 1,350
Resistance(MΩ)	4.87

Accelerator Position Sensor (APS)

> Type: Variable resistor type

- > Specification
- •

Accelerator	Output Vo	• • •
Position	APS1	APS2
C.T	0.7 ~ 0.8	0.29 ~ 0.46
W O T	3 85 ~ 4 35	1 93 ~ 2 18

## **Actuators**

Item	Specification
Coil Resistance (Ω)	13.8 ~ 15.2 [20°C (68°F)]

### ETC Motor [integrated into ETC Module]

Item	Specification
Coil Resistance (Ω)	0.3 ~ 100 (20°C)

Purge Control Solenoid Valve (PCSV)

Item	Specification	
Coil Resistance (Ω)	14.0 ~ 18.0 [20°C (68°F)]	

Cvvt Oil Control Valve (OCV)

Item	Specification	
Coil Resistance (Ω)	6.9 ~ 7.9 [20°C (68°F)]	

Ignition Coil

ltem	Specification
Primary Coil Resistance (Ω)	0.82±15% [20°C (68°F)]
Secondary Coil Resistance (kΩ)	15.5±15% [20°C (68°F)]

# **SERVICE STANDARD**

Ignition Timing	BTDC 6° ± 10°		
Idle Speed	A/CON OFF	Neutral,N,P-range	700 ± 100 rpm
	AVCON OFF	D-range	720 ± 100 rpm
	A/CON ON	Neutral	800 ± 100 rpm
		D, N, P-range	820 ± 100 rpm

# **TIGHTENING TORQUES**

# **Engine Control System**

Item	Kgf.m	N.m	lb-ft
ECM installation nut	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4
ECM installation bolt	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4
ECM bracket installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Manifold absolute pressure sensor installation screw	0.65 ~ 0.85	6.4 ~ 8.3	4.7 ~ 6.1
Engine coolant temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.4 ~ 28.9
Crankshaft position sensor installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7

Camshaft position sensor (Bank 1 / Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Camshaft position sensor (Bank 1 / Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Knock sensor installation bolt	1.7 ~ 2.6	16.7 ~ 25.5	12.3 ~ 18.8
Heated oxygen sensor (Bank 1 / Sensor 1) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Heated oxygen sensor (Bank 1 / Sensor 2) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
ETC module installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Purge Control Solenoid Valve (PCSV) bracket installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 1 / Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 1 / Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Ignition coil installation bolt	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4

# Fuel Delivery System

ltem	Kgf.m	N.m	lb-ft
Fuel tank installation nut	4.0 ~ 5.5	39.2 ~ 53.9	28.9 ~ 39.8
Fuel pump plate installation nut	0.2 ~ 0.3	1.9 ~ 2.9	1.4 ~ 2.1
Filler-neck assembly bracket installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Filler-neck assembly installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Delivery pipe installation bolt	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4
Delivery pipe installation nut(↔ Fuel feed tube)	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Accelerator pedal module installation nut	1.0 ~ 1.5	9.8 ~ 14.7	7.2 ~ 10.9

#### **BASIC TROUBLESHOOTING**

#### BASIC TROUBLESHOOTING GUIDE

- 1 Bring Vehicle to Workshop
- 2 Analyze Customer's Problem
- Ask the customer about the conditions and environment relative to the issue.
   (Use CUSTOMER PROBLEM ANALYSIS SHEET).
- 3 Verify Symptom, and then Check DTC and Freeze Frame Data
- Connect the GDS to Diagnostic Link Connector (DLC).
- Record the DTC and Freeze Frame Data.
  - information

To erase DTC and Freeze Frame Data, refer to Step 5.

- 4 Confirm the Inspection Procedure for the System or Part
- Using the SYMPTOM TROUBLESHOOTING GUIDE CHART, choose the correct inspection procedure for the system or part to be checked.
- 5 Erase the DTC and Freeze Frame Data

#### NOTICE

NEVER erase DTC and Freeze Frame Data before completing Step 2 : MIL/DTC in CUSTOMER PROBLEM ANALYSIS SHEET.

- 6 Inspect Vehicle Visually
- · Go to Step 11, if you recognize the problem.
- 7 Recreate (Simulate) Symptoms of the DTC
- · Try to recreate or simulate the symptoms and conditions of the malfunction as described by customer.
- If DTC(s) is/are displayed, simulate the condition according to troubleshooting procedure for the DTC.
- 8 Confirm Symptoms of Problem
- If DTC(s) is/are not displayed, go to Step 9.
- If DTC(s) is/are displayed, go to Step 11.
- 9 Recreate (Simulate) Symptom
- Try to recreate or simulate the condition of the malfunction as described by the customer.
- 10 Check the DTC
- If DTC(s) does(do) not occur, refer to INTERMITTENT PROBLEM PROCEDURE in BASIC INSPECTION PROCEDURE.
- If DTC(s) occur(s), go to Step 11.
- 11 Perform Troubleshooting Procedure for DTC
- 12 Adjust or repair the vehicle
- 13 Confirmation test
- 14 END

#### Customer Problem Analysis Sheet VEHICLEINFORMAITON VIN No. Transmission ☐ M/T ☐ A/T ☐ CVT ☐ etc. Production date Driving type □ 2WD (FF) □ 2WD (FR) □ 4WD Odometer CPF \_\_\_\_km/mile ☐ With CPF ☐ Without CPF Reading (Diesel Engine) SYMPTOMS □ Engine does not turn over □ Incomplete combustion ☐ Unable to start Initial combustion does not occur Difficult to start □ Engine turns over slowly □ Other\_ □ Rough idling □ Incorrect idling ☐ Unstable idling (High: \_\_\_\_\_rpm, Low: \_\_\_\_rpm) □ Poor idling □ Other □ Soon after starting □ After accelerator pedal depressed □ After accelerator pedal released □ During A/C ON Engine stall ☐ Shifting from N to D-range □ Other\_ □ Poor driving (Surge) □ Knocking □ Poor fuel economy □ Others ☐ Back fire ☐ After fire ☐ Other ENVIRONMENT □ Constant □ Sometimes (\_\_\_\_\_) □ Once only Problem frequency ☐ Other\_ Weather □ Fine □ Cloudy □ Rainy □ Snowy □ Other\_\_\_ °C/°F Outdoor temperature Approx. ☐ Highway ☐ Suburbs ☐ Inner City ☐ Uphill ☐ Downhill Place □ Rough road □ Other\_ Engine temperature □ Cold □ Warming up □ After warming up □ Any temperature □ Starting □ Just after starting (\_\_\_\_min) □ Idling □ Racing Engine operation □ Driving □ Constant speed □ Acceleration □ Deceleration □ A/C switch ON/OFF □ Other ■ MIL/DTC MIL (Malfunction Indicator □ Remains ON □ Sometimes lights up □ Does not light Lamp) Normal check □ Normal □ DTC (\_\_ (Pre-check) ☐ Freeze Frame Data DTC □ Normal □ DTC ( Check mode ☐ Freeze Frame Data ECM/PCM INFORMATION ECM/PCM Part No. RÔM ID

### **Basic Inspection Procedure**

### Measuring Condition Of Electronic Parts' Resistance

The measured resistance at high temperature after vehicle running may be high or low. So all resistance must be measured at ambient temperature (20°C, 68°F), unless stated otherwise.

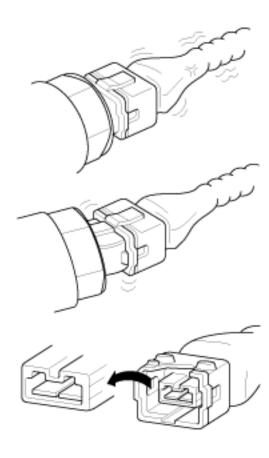
### NOTICE

The measured resistance in except for ambient temperature (20°C, 68°F) is reference value.

### **Intermittent Problem Inspection Procedure**

Sometimes the most difficult case in troubleshooting is when a problem symptom occurs but does not occur again during testing. An example would be if a problem appears only when the vehicle is cold but has not appeared when warm. In this case, the technician should thoroughly make out a "CUSTOMER PROBLEM ANALYSIS SHEET" and recreate (simulate) the environment and condition which occurred when the vehicle was having the issue.

- 1. Clear Diagnostic Trouble Code (DTC).
- 2. Inspect connector connection, and check terminal for poor connections, loose wires, bent, broken or corroded pins, and then verify that the connectors are always securely fastened.



- 3. Slightly shake the connector and wiring harness vertically and horizontally.
- 4. Repair or replace the component that has a problem.
- 5. Verify that the problem has disappeared with the road test.
- SIMULATING VIBRATION
- a. Sensors and Actuators
  - : Slightly vibrate sensors, actuators or relays with finger.

## **▲** WARNING

Strong vibration may break sensors, actuators or relays

- b. Connectors and Harness
  - : Lightly shake the connector and wiring harness vertically and then horizontally.
- SIMULATING HEAT
- a. Heat components suspected of causing the malfunction with a hair dryer or other heat source.

## **▲** WARNING

- DO NOT heat components to the point where they may be damaged.
- DO NOT heat the ECM directly.

- SIMULATING WATER SPRINKLING
- a. Sprinkle water onto vehicle to simulate a rainy day or a high humidity condition.

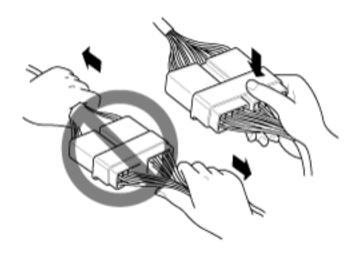
## **AWARNING**

DO NOT sprinkle water directly into the engine compartment or electronic components.

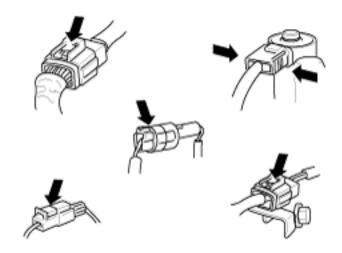
- SIMULATING ELECTRICAL LOAD
- a. Turn on all electrical systems to simulate excessive electrical loads (Radios, fans, lights, rear window defogger, etc.).

## Connector Inspection Procedure

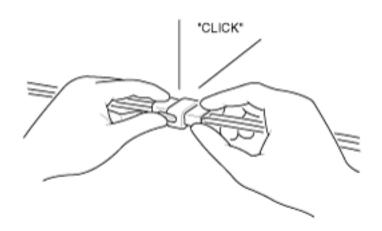
- 1. Handling of Connector
  - a. Never pull on the wiring harness when disconnecting connectors.



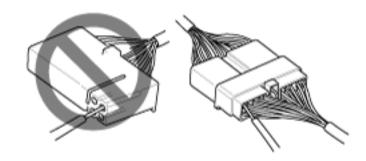
b. When removing the connector with a lock, press or pull locking lever.



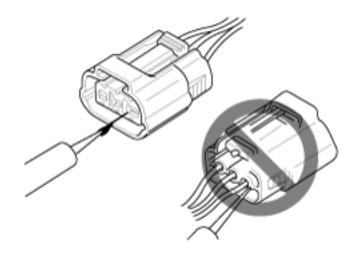
c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.

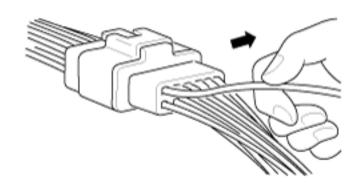


e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



## NOTICE

- Use a fine wire to prevent damage to the terminal.
- Do not damage the terminal when inserting the tester lead.
- 2. Checking Point for Connector
  - a. While the connector is connected:
     Hold the connector, check connecting condition and locking efficiency.
  - b. When the connector is disconnected:
     Check missed terminal, crimped terminal or broken core wire by slightly pulling the wire harness.
     Visually check for rust, contamination, deformation and bend.
  - c. Check terminal tightening condition: Insert a spare male terminal into a female terminal, and then check terminal tightening conditions.
  - d. Pull lightly on individual wires to ensure that each wire is secured in the terminal.



- 3. Repair Method of Connector Terminal
  - a. Clean the contact points using air gun and/or shop rag.

### NOTICE

Never use sand paper when polishing the contact points, otherwise the contact point may be damaged.

b. In case of abnormal contact pressure, replace the female terminal.

## Wire Harness Inspection Procedure

- 1. Before removing the wire harness, check the wire harness position and crimping in order to restore it correctly.
- 2. Check whether the wire harness is twisted, pulled or loosened.
- 3. Check whether the temperature of the wire harness is abnormally high.
- 4. Check whether the wire harness is rotating, moving or vibrating against the sharp edge of a part.
- 5. Check the connection between the wire harness and any installed part.
- 6. If the covering of wire harness is damaged; secure, repair or replace the harness.

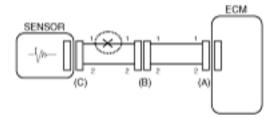
### **Electrical Circuit Inspection Procedure**

### Check Open Circuit

- Procedures for Open Circuit
  - · Continuity Check
  - Voltage Check

If an open circuit occurs (as seen in [FIG. 1]), it can be found by performing Step 2 (Continuity Check Method) or Step 3 (Voltage Check Method) as shown below.

FIG 1



2. Continuity Check Method

## NOTICE

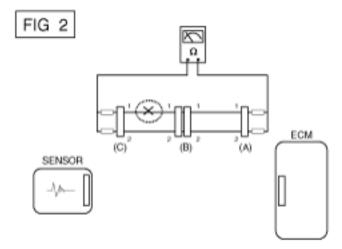
When measuring for resistance, lightly shake the wire harness above and below or from side to side.

Specification (Resistance)

1Ω or less → Normal Circuit

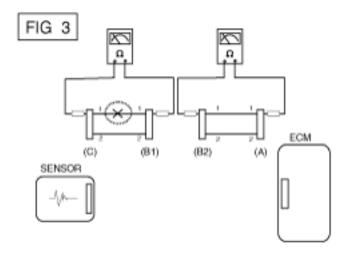
 $1M\Omega$  or Higher  $\rightarrow$  Open Circuit

a. Disconnect connectors (A), (C) and measure resistance between connector (A) and (C) as shown in [FIG. 2]. In [FIG.2.] the measured resistance of line 1 and 2 is higher than  $1M\Omega$  and below 1  $\Omega$  respectively. Specifically the open circuit is line 1 (Line 2 is normal). To find exact break point, check sub line of line 1 as described in next step.



b. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

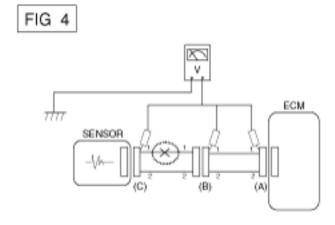
In this case the measured resistance between connector (C) and (B1) is higher than  $1M\Omega$  and the open circuit is between terminal 1 of connector (C) and terminal 1 of connector (B1).



#### 3. Voltage Check Method

a. With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].

The measured voltage of each connector is 5V, 5V and 0V respectively. So the open circuit is between connector (C) and (B).

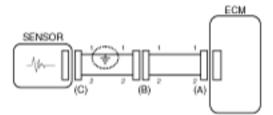


#### Check Short Circuit

- 1. Test Method for Short to Ground Circuit
  - Continuity Check with Chassis Ground

If short to ground circuit occurs as shown in [FIG. 5], the broken point can be found by performing Step 2 (Continuity Check Method with Chassis Ground) as shown below.

FIG 5



2. Continuity Check Method (with Chassis Ground)

### NOTICE

Lightly shake the wire harness above and below, or from side to side when measuring the resistance.

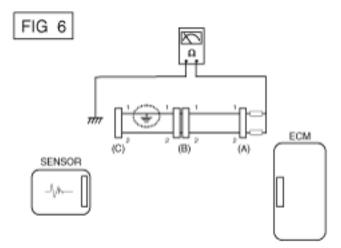
Specification (Resistance)

 $1\Omega$  or less  $\rightarrow$  Short to Ground Circuit

 $1M\Omega$  or Higher  $\rightarrow$  Normal Circuit

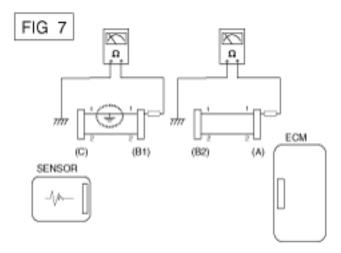
a. Disconnect connectors (A), (C) and measure for resistance between connector (A) and Chassis Ground as shown in [FIG. 6].

The measured resistance of line 1 and 2 in this example is below 1  $\Omega$  and higher than 1M $\Omega$  respectively. Specifically the short to ground circuit is line 1 (Line 2 is normal). To find exact broken point, check the sub line of line 1 as described in the following step.



b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

The measured resistance between connector (B1) and chassis ground is  $1\Omega$  or less. The short to ground circuit is between terminal 1 of connector (C) and terminal 1 of connector (B1).



# Symptom Troubleshooting Guide Chart

1) Test the battery

2) Test the starter

**Main Symptom** 

(Engine does not turn

Unable to start

over)

over)	3) Inhibitor switch (A/T) or clutch start switch (M/T)	
Unable to start (Incomplete combustion)	<ol> <li>Test the battery</li> <li>Check the fuel pressure</li> <li>Check the ignition circuit</li> <li>Troubleshooting the immobilizer system (In case of immobilizer lamp flashing)</li> </ol>	<ul> <li>DTC</li> <li>Low compression</li> <li>Intake air leaks</li> <li>Slipped or broken timing belt</li> <li>Contaminated fuel</li> </ul>
Difficult to start	<ol> <li>Test the battery</li> <li>Check the fuel pressure</li> <li>Check the ECT sensor and circuit (Check DTC)</li> <li>Check the ignition circuit</li> </ol>	<ul> <li>DTC</li> <li>Low compression</li> <li>Intake air leaks</li> <li>Contaminated fuel</li> <li>Weak ignition spark</li> </ul>
Poor idling (Rough, unstable or incorrect Idle)	<ol> <li>Check the fuel pressure</li> <li>Check the Injector</li> <li>Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM)</li> <li>Check the idle speed control circuit (Check DTC)</li> <li>Inspect and test the Throttle Body</li> <li>Check the ECT sensor and circuit (Check DTC)</li> </ol>	<ul> <li>DTC</li> <li>Low compression</li> <li>Intake air leaks</li> <li>Contaminated fuel</li> <li>Weak ignition spark</li> </ul>
Engine stall	<ol> <li>Test the Battery</li> <li>Check the fuel pressure</li> <li>Check the idle speed control circuit (Check DTC)</li> <li>Check the ignition circuit</li> <li>Check the CKPS Circuit (Check DTC)</li> </ol>	DTC     Intake air leaks     Contaminated fuel     Weak ignition spark
Poor driving (Surge)	<ol> <li>Check the fuel pressure</li> <li>Inspect and test Throttle Body</li> <li>Check the ignition circuit</li> <li>Check the ECT Sensor and Circuit (Check DTC)</li> <li>Test the exhaust system for a possible restriction</li> <li>Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM)</li> </ol>	DTC     Low compression     Intake air leaks     Contaminated fuel     Weak ignition spark

**Diagnostic Procedure** 

**Also Check For** 

	1) Check the fuel pressure	
Knocking	2) Inspect the engine coolant	• DTC
	3) Inspect the radiator and the electric cooling fan	Contaminated fuel
	4) Check the spark plugs	
Poor fuel economy	<ol> <li>Check customer's driving habits</li> <li>Is A/C on full time or the defroster mode on?</li> <li>Are tires at correct pressure?</li> <li>Is excessively heavy load being carried?</li> <li>Is acceleration too much, too often?</li> <li>Check the fuel pressure</li> <li>Check the injector</li> <li>Test the exhaust system for a possible restriction</li> <li>Check the ECT sensor and circuit</li> </ol>	<ul> <li>DTC</li> <li>Low compression</li> <li>Intake air leaks</li> <li>Contaminated fuel</li> <li>Weak ignition spark</li> </ul>
Hard to refuel (Overflow during refueling)	<ol> <li>Test the canister close valve</li> <li>Inspect the fuel filler hose/pipe         <ul> <li>Pinched, kinked or blocked?</li> <li>Filler hose is torn</li> </ul> </li> <li>Inspect the fuel tank vapor vent hose between the EVAP. canister and air filter</li> <li>Check the EVAP. canister</li> </ol>	Malfunctioning gas station filling nozzle (If this problem occurs at a specific gas station during refueling)

## **BASIC SERVICE SYMBOLS**

There are five primary symbols used to complement illustrations. These symbols indicate the part to apply such materials during

Symbol	Meaning
	Do not reuse the part. Replace a new one.
ōL	Apply engine oil or transmission oil to the part.
ATF	Apply automatic transmission fluid (ATF) to the part.
GREASE	Apply grease to the part.
SEALANT	Apply sealant to the part.

### **GENERAL SERVICE INFORMATION**

### Protection of The Vehicle

Always be sure to cover fenders, seats, and floor areas before starting work.

## **A** CAUTION

The support rod must be inserted into the hole near the edge of the hood whenever you inspect the engine compartment to prevent the hood from falling and causing possible injury.

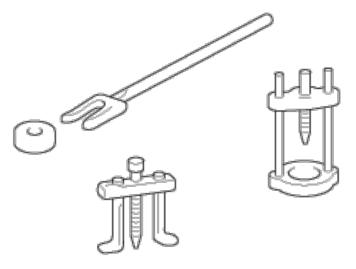
Make sure that the support rod has been released prior to closing the hood. Always check to be sure the hood is firmly latched before driving the vehicle.

### Preparation of Tools and Measuring Equipment

Be sure that all necessary tools and measuring equipment are available starting work.

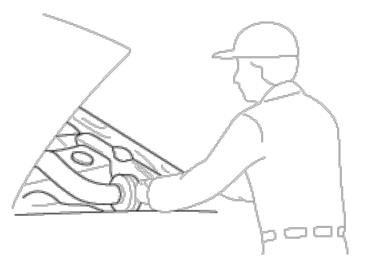
### Special Tools

Use special tools when they are required.



#### **Removal of Parts**

First find the cause of the problem and then determine whether removal or disassembly before starting the job.

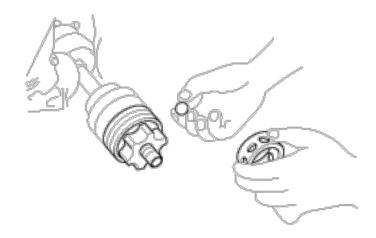


### Disassembly

If the disassembly procedure is complex, requiring many parts to be disassembled, all parts should be disassembled in a way that will not affect their performance or external appearance.

#### 1) Inspection of parts

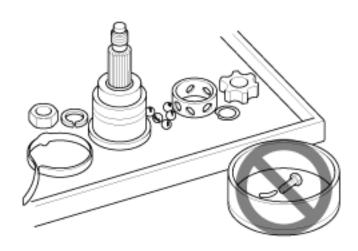
Each part, when removed, should be carefully on suspected for malfunction, deformation, damage, and other problems.



### 2) Arrangement of parts

All disassembled parts should be carefully arranged for effective reassembly.

Be sure to separate and correctly identify the parts to be replaced from those that will be used again.



### 3) Cleaning parts for reuse

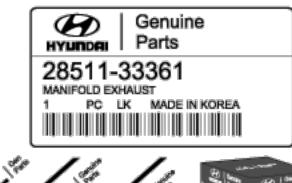
All parts to be used again should be carefully and thoroughly cleaned by an appropriate method.

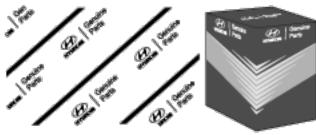


### **Parts**

When replacing parts, use HYUNDAI genuine parts.



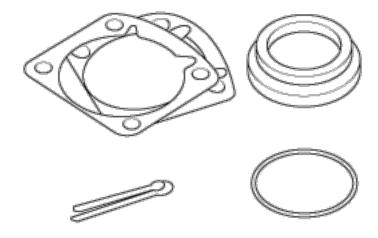




### Replacement

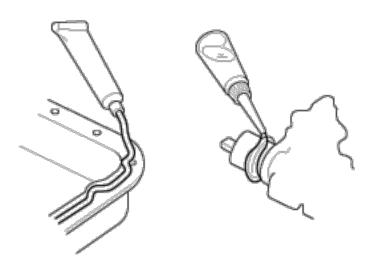
Standard values, such as torques and certain adjustments, must be strictly observed in the reassembly of all parts. If removed, the following parts should always be replaced with new ones.

- 1) Oil seals
- 2) Gaskets
- 3) O-rings
- 4) Lock washers
- 5) Cotter pins (split pins)
- 6) Plastic nuts



Depending on their location.

- 7) Sealant should be applied to gaskets.
- 8) Oil should be applied to the moving components of parts.
- 9) Specified oil or grease should be applied to the prescribed locations (oil seals, etc) before assembly.

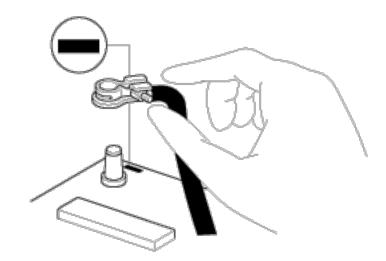


### Adjustment

Use gauges and testers to adjust correctly the parts to standard values correctly.

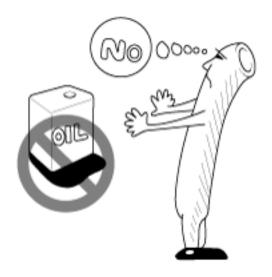
## **Electrical System**

- 1. Be sure to disconnect the battery cable from the negative (-) terminal of the battery.
- 2. Never pull on the wires when disconnecting connectors.
- 3. Locking connectors will click when the connector is secure.
- 4. Handle sensors and relays carefully. Be careful not to drop them against other parts.



### **Rubber Parts and Tubes**

Always prevent gasoline or from touching rubber parts or tubing.



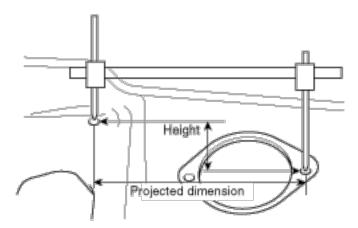
## **Measuring Body Dimensions**

- 1. Basically, all measurements in this manual are taken with a tracking gauge.
- 2. When a measuring tape is used, check to be sure there is no elongation, twisting or bending.
- 3. For measuring dimensions, both projected dimensions and actual measurement dimensions are used in this

manual.

## **Dimensions Projected**

- 1. These are the dimensions measured when the measurement points are projected from the vehicle's surface, and are the reference dimensions used for used for body alterations.
- 2. If the length of the tracking gauge probes is adjustable, measure it by lengthening one of two probes as long as the different value in height of the two surface.

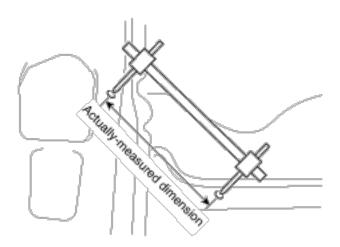


## **Measuring Actual Dimensions**

- 1. These dimensions indicate the actual linear distance between measurement points, and are used as the reference dimensions when a tracking gauge is used for measurement.
- 2. First adjust both probes to the same length (A=A') before measurement.

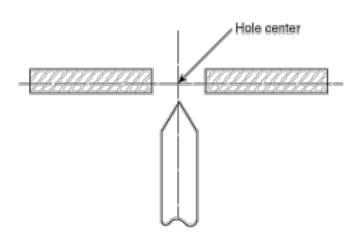
## NOTICE

Check the probes and gauge itself to make sure there is no free play.



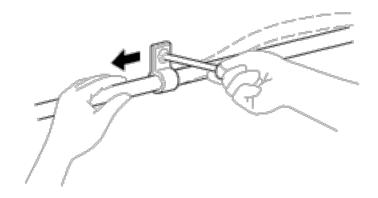
### **Measurement Point**

Measurements should be taken at the center of the hole.



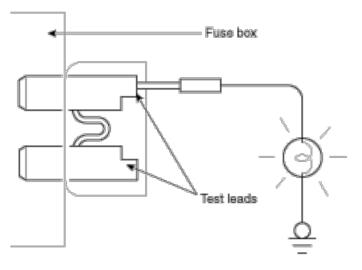
## Checking Cables and Wires

- 1. Check the terminal for tightness.
- 2. Check terminals and wires for corrosion from battery electrolyte, etc.
- 3. Check terminals and wires for open circuits.
- 4. Check wire insulation and coating for damage, cracks and degrading.
- 5. Check the conductive parts of terminals for contact with other metallic parts (vehicle body and other parts).
- 6. Check grounded parts to verify that there is complete continuity between their attaching bolt(s) and the vehicle's body.
- 7. Check for incorrect wiring.
- 8. Check that the wiring is so clamped to the prevent contact with sharp corners of the vehicle body, etc. or hot parts (exhaust manifold, etc.)
- 9. Check that the wiring is clamped firmly to provide enough clearance from the fan pulley, fan belt and other rotating or moving parts.
- 10. Check that the wiring has a little space so that it can vibrate between fixed and moving parts such as the vehicle body and the engine.



#### Check Fuses

A blade type fuse test taps provided to allow checking the fuse itself without removing if from the fuse box. The fuse is good if the test lamp lights up when one lead is connected to the test taps (one at a time) and the other lead is grounded. (Turn the ignition switch so that the fuse circuit becomes operative)

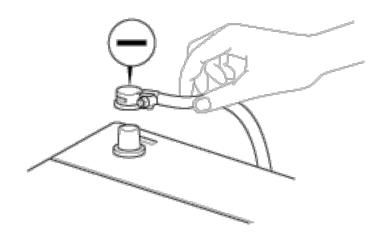


## Servicing the Electrical System

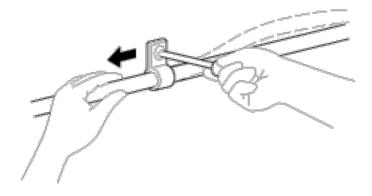
1. Prior to servicing the electrical system, be sure to turn off the ignition switch and disconnect the battery ground cable.

### NOTICE

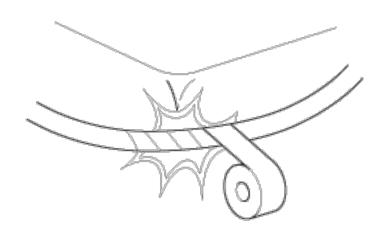
In the course of MFI or ELC system diagnosis, when the battery cable is removed, any diagnostic trouble code retained by the computer will be cleared. There fore, if necessary, record the diagnostic data before removing the battery cable.



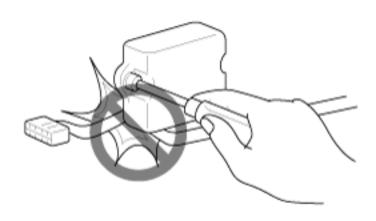
2. Attach the wiring harnesses with clamps so that there is no slack. However, for any harness which passes the engine or other vibrating parts of the vehicle, allow some slack within a range that does not allow the engine vibrations to cause the harness to come into contact with any of the surrounding parts and then secure the harness by using a clamp.



3. If any section of a wiring harness interferes with the edge of a parts, or a corner, wrap the section of the harness with tape or something similar in order to protect if from damage.



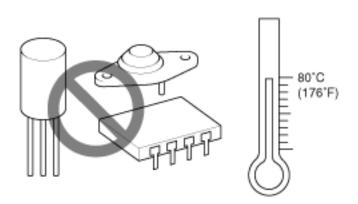
4. When installing any parts, be careful not to pinch or damage any of the wiring harness.



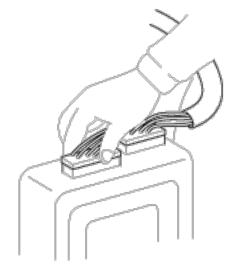
5. Never throw relays, sensors or electrical parts, or expose them to strong shock.



6. The electronic parts used in the computer, relays, etc. are readily damaged by heat. If there is a need for service operations that may cause the temperature to exceed 80°C (176°F), remove the electronic parts before hand.



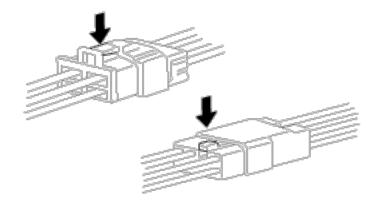
7. Loose connectors cause problems. Make sure that the connectors are always securely fastened.



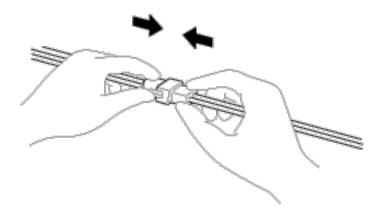
8. When disconnecting a connector, be sure to grip only the connector, not the wires.



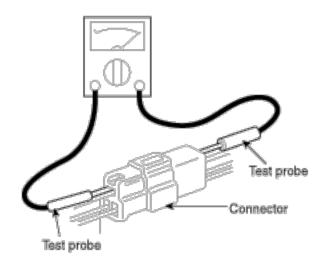
9. Disconnect connector which have catches by pressing in the direction of the arrows shown the illustration.



10. Connect connectors which have catches by inserting the connectors until they make a clicking sound.



11. When using a circuit tester to check continuity or voltage on connector terminals, insert the test probe into the harness side. If the connector is a sealed connector, insert the test probe through the hole in the rubber cap until contacts the terminal, being careful not to damage the insulation of the wires.



12. To avoid overloading the wiring, take the electrical current load of the optional equipment into consideration, and determine the appropriate wire size.

Nominal	ominal Permissible current		current
size	SAE gauge No	In engine compartment	Other areas
0.3mm²	AWG 22	-	5A
0.5mm²	AWG 20	7A	13A
0.85mm²	AWG 18	9A	17A
1.25mm²	AWG 16	12A	22A
2.0mm²	AWG 14	16A	30A
3.0mm²	AWG 12	21A	40A
5.0mm²	AWG 10	31A	54A

## **Precautions For Catalytic Converter**

## **▲** CAUTION

If a large amount of unburned gasoline flows into the converter, it may overheat and create a fire hazard. To prevent this observe the following precautions and explain them to your customer.

- 1. Use only unleaded gasoline.
- 2. Do not run the engine while the car is at rest for a long time. Avoid running the engine at fast idle for more than 10minutes and idle speed for more than 20 minutes.
- 3. Do not measure engine compression for an extended time. Engine compression tests must be made as rapidly as possible. Remove the fuel pump relay before performing a compression test.
- 4. Do not dispose of used catalytic converter together with parts contaminated with gasoline or oil.

# TIGHTENING TORQUE TABLE OF STANDARD PARTS

BOLT (Nominal diameter)	NUT (Nominal diameter)
ROLT/NUT Thin screw	Torque Nm (kg m lh-ft)

BOLT/NUT Thin screw		Torque Nm (kg.m, lb-ft)		
	Pitch [mm (in.) ]	4T	8T	10T
Nominal diameter. (mm)		(4) (1) (A) (A) (A) (A) (A) (A) (A) (A) (A) (A	8	(10)
M5	0.8 (0.031)	2.0 ~ 3.0 (0.2 ~ 0.3, 1.4 ~ 2.2)	4.9 ~ 6.9 (0.5 ~ 0.7, 3.6 ~ 5.1)	7.8 ~ 10.8 (0.8 ~ 1.1, 5.8 ~ 8.0)
M6	1 (0.039)	2.9 ~ 4.9 (0.3 ~ 0.5, 2.2 ~ 3.6)	8.8 ~ 12.7 (0.9 ~ 1.3, 6.5 ~ 9.4)	13.7 ~ 18.6 (1.4 ~ 1.9, 10.1 ~ 13.7)
M8	1.25 (0.049)	8.8 ~ 11.8 (0.9 ~ 1.2, 6.5 ~ 8.7)	22.6 ~ 30.4 (2.3 ~ 3.1, 16.6 ~ 22.4)	33.3 ~ 44.1 (3.4 ~ 4.5, 24.6 ~ 32.5)
M10	1.5 (0.059)	16.7 ~ 22.6 (1.7 ~ 2.3, 12.3 ~ 16.6)	45.1 ~ 60.8 (4.6 ~ 6.2, 33.3 ~ 44.8)	65.7 ~ 88.3 (6.7 ~ 9.0, 48.5 ~ 65.1)
M12	1.75 (0.068)	29.4 ~ 39.2 (3.0 ~ 4.0, 21.7 ~ 28.9)	78.5 ~ 105.9 (8.0 ~ 10.8, 57.9 ~ 78.1)	114.7 ~ 154.9 (11.7 ~ 15.8, 84.6 ~ 114.3)
M14	2 (0.078)	47.1 ~ 63.7 (4.8 ~ 6.5, 34.7 ~ 47.0)	125.5 ~ 169.7 (12.8 ~ 17.3, 92.6 ~ 125.1)	183.4 ~ 249.1 (18.7 ~ 25.4, 135.3 ~ 183.7)
M16	2 (0.078)	73.5 ~ 100.0 (7.5 ~ 10.2, 54.2 ~ 73.8)	197.1 ~ 266.7 (20.1 ~ 27.2, 145.4 ~ 196.7)	288.3 ~ 390.3 (29.4 ~ 39.8, 212.7 ~ 287.9)
M20	2.5 (0.098)	144.2 ~ 195.2 (14.7 ~ 19.9, 106.3 ~ 143.9)	396.2 ~ 535.4 (40.4 ~ 54.6, 292.2 ~ 394.9)	565.8 ~ 764.9 (57.7 ~ 78.0, 417.3 ~ 564.2)
M24	3 (0.118)	249.1 ~ 337.3 (25.4 ~ 34.4, 183.7 ~ 248.8)	687.4 ~ 929.7 (70.1 ~ 94.8, 507.0 ~ 685.7)	975.8 ~ 1320.0 (99.5 ~ 134.6, 719.7 ~ 973.6)

M30	3.5 (0.137)	68.8, 368.2 ~ 497.6)	189.5, 1012.6 ~ 1370.7)	`
M20 2.5 (0.127)	499.2 ~ 674.7 (50.9 ~	1372.9 ~ 1858.4 (140.0 ~	1956.4 ~ 2647.8 (199.5 ~	

BOL	BOLT/NUT Thin screw Torque Nm (kg.m, lb-ft)			
	Pitch [mm (in.) ]	4T	8T	10T
Nominal diameter. (mm)		(4)(1)()()()()()()()()()()()()()()()()()	8	(10)
M5	0.5 (0.019)	2.0 ~ 3.0 (0.2 ~ 0.3, 1.4 ~ 2.2)	5.9 ~ 8.8 (0.6 ~ 0.9, 4.3 ~ 6.5)	8.8 ~ 12.7 (0.9 ~ 1.3, 6.5 ~ 9.4)
M6	0.75 (0.029)	3.9 ~ 4.9 (0.4 ~ 0.5, 2.9 ~ 3.6)	9.8 ~ 13.7 (1.0 ~ 1.4, 7.2 ~ 10.1)	14.7 ~ 20.6 (1.5 ~ 2.1, 10.8 ~ 15.2)
M8	1 (0.039)	8.8 ~ 11.8 (0.9 ~ 1.2, 6.5 ~ 8.7)	24.5 ~ 32.4 (2.5 ~ 3.3, 18.1 ~ 23.9)	35.3 ~ 48.1 (3.6 ~ 4.9, 26.0 ~ 35.4)
M10	1.25 (0.049)	17.7 ~ 23.5 (1.8 ~ 2.4, 13.0 ~ 17.4)	47.1 ~ 63.7 (4.8 ~ 6.5, 34.7 ~ 47.0)	69.6 ~ 94.1 (7.1 ~ 9.6, 51.4 ~ 69.4)
M12	1.25 (0.049)	32.4 ~ 44.1 (3.3 ~ 4.5, 23.9 ~ 32.5)	86.3 ~ 117.7 (8.8 ~ 12.0, 63.7 ~ 86.8)	127.5 ~ 172.6 (13.0 ~ 17.6, 94.0 ~ 127.3)
M14	1.5 (0.059)	51.0 ~ 69.6 (5.2 ~ 7.1, 37.6 ~ 51.4)	136.3 ~ 185.3 (13.9 ~ 18.9, 100.5 ~ 136.7)	201.0 ~ 271.6 (20.5 ~ 27.7, 148.3 ~ 200.4)
M16	1.5 (0.059)	79.4 ~ 107.9 (8.1 ~ 11.0, 58.6 ~ 79.6)	211.8 ~ 286.4 (21.6 ~ 29.2, 156.2 ~ 211.2)	311.8 ~ 421.7 (31.8 ~ 43.0, 230.0 ~ 311.0)
M20	1.5 (0.059)	163.8 ~ 221.6 (16.7 ~ 22.6, 120.8 ~ 163.5)	448.2 ~ 607.0 (45.7 ~ 61.9, 330.5 ~ 447.7)	639.4 ~ 864.9 (65.2 ~ 88.2, 471.6 ~ 638.0)
M24	2 (0.078)	276.5 ~ 373.6 (28.2 ~ 38.1, 204.0 ~ 275.6)	759.0 ~ 1026.8 (77.4 ~ 104.7, 559.8 ~ 757.3)	1080.7 ~ 1462.2 (110.2 ~ 149.1, 797.1 ~ 1078.4)
M30	2 (0.078)	562.9 ~ 762.0 (57.4 ~ 77.7, 415.2 ~ 562.0)	1553.4 ~ 2102.5 (158.4 ~ 214.4, 1145.7 ~ 1550.8)	2210.4 ~ 2991.0 (225.4 ~ 305.0, 1630.3 ~ 2206.1)

Flange BOLT (Nominal diameter)	Flange NUT (Nominal diameter)

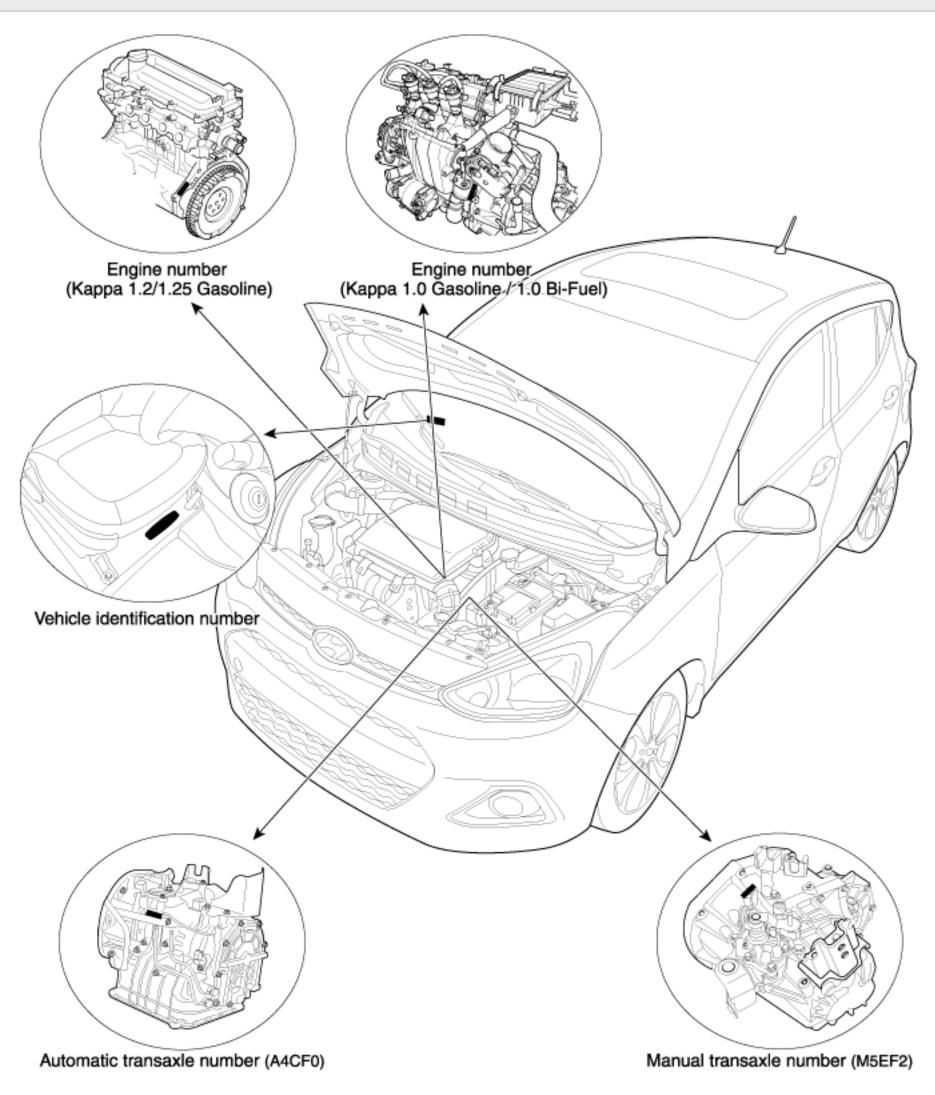
OLT/NUT Normal screw	Torque Nm (kg.m, lb-ft)		
Pitch [mm (in.) ]	4T	8T	10T
	4	8	10
0.8 (0.031)	2.0 ~ 2.9 (0.2 ~ 0.3, 1.4 ~ 2.2)	5.9 ~ 7.8 (0.6 ~ 0.8, 4.3 ~ 5.8)	8.8 ~ 11.8 (0.9 ~ 1.2, 6.5 ~ 8.7)
1 (0.039)	3.9 ~ 4.9 (0.4 ~ 0.5, 2.9 ~ 3.6)	9.8 ~ 13.7 (1.0 ~ 1.4, 7.2 ~ 10.1)	14.7 ~ 19.6 (1.5 ~ 2.0, 10.8 ~ 14.5)
1.25 (0.049)	8.8 ~ 11.8 (0.9 ~ 1.2, 6.5 ~ 8.7)	24.5 ~ 32.4 (2.5 ~ 3.3, 18.1 ~ 23.9)	35.3 ~ 48.1 (3.6 ~ 4.9, 26.0 ~ 35.4)
1.5 (0.059)	17.7 ~ 24.5 (1.8 ~ 2.5, 13.0 ~ 18.1)	48.1 ~ 65.7 (4.9 ~ 6.7, 35.4 ~ 48.5)	70.6 ~ 96.1 (7.2 ~ 9.8, 52.1 ~ 70.9)
1.75 (0.068)	31.4 ~ 43.1 (3.2 ~ 4.4, 23.1 ~ 31.8)	84.3 ~ 113.8 (8.6 ~ 11.6, 62.2 ~ 83.9)	123.6 ~ 167.7 (12.6 ~ 17.1, 91.1 ~ 123.7)
2 (0.078)	51.0 ~ 68.6 (5.2 ~ 7.0, 37.6 ~ 50.6)	135.3 ~ 182.4 (13.8 ~ 18.6, 99.8 ~ 134.5)	198.1 ~ 268.7 (20.2 ~ 27.4, 146.1 ~ 198.2)
2 (0.078)	79.4 ~ 107.9 (8.1 ~ 11.0, 58.6 ~ 79.6)	212.8 ~ 288.3 (21.7 ~ 29.4, 157.0 ~ 212.7)	311.8 ~ 421.7 (31.8 ~ 43.0, 230.0 ~ 311.0)
	<i>4</i> T		10T
	4	8	10
0.5 (0.019)	2.9 ~ 2.9 (0.3 ~ 0.3, 2.2 ~ 2.2)	6.9 ~ 8.8 (0.7 ~ 0.9, 5.1 ~ 6.5)	9.8 ~ 13.7 (1.0 ~ 1.4, 7.2 ~ 10.1)
0.75 (0.029)	3.9 ~ 5.9 (0.4 ~ 0.6, 2.9 ~ 4.3)	10.8 ~ 14.7 (1.1 ~ 1.5, 8.0 ~ 10.8)	16.7 ~ 21.6 (1.7 ~ 2.2, 12.3 ~ 15.9)
1 (0.039)	9.8 ~ 12.7 (1.0 ~ 1.3, 7.2 ~ 9.4)	26.5 ~ 35.3 (2.7 ~ 3.6, 19.5 ~ 26.0)	38.2 ~ 52.0 (3.9 ~ 5.3, 28.2 ~ 38.3)
1.25 (0.049)	19.6 ~ 25.5 (2.0 ~ 2.6, 14.5 ~ 18.8)	51.0 ~ 68.6 (5.2 ~ 7.0, 37.6 ~ 50.6)	75.5 ~ 102.0 (7.7 ~ 10.4, 55.7 ~ 75.2)
	Pitch [mm (in.)]  0.8 (0.031)  1 (0.039)  1.25 (0.049)  1.5 (0.068)  2 (0.078)  2 (0.078)  BOLT/NUT Thin screw Pitch [mm (in.)]  0.5 (0.019)  0.75 (0.029)  1 (0.039)	Pitch [mm (in.)]       4T         0.8 (0.031)       2.0 ~ 2.9 (0.2 ~ 0.3, 1.4 ~ 2.2)         1 (0.039)       3.9 ~ 4.9 (0.4 ~ 0.5, 2.9 ~ 3.6)         1.25 (0.049)       8.8 ~ 11.8 (0.9 ~ 1.2, 6.5 ~ 8.7)         1.5 (0.059)       17.7 ~ 24.5 (1.8 ~ 2.5, 13.0 ~ 18.1)         1.75 (0.068)       31.4 ~ 43.1 (3.2 ~ 4.4, 23.1 ~ 31.8)         2 (0.078)       51.0 ~ 68.6 (5.2 ~ 7.0, 37.6 ~ 50.6)         2 (0.078)       79.4 ~ 107.9 (8.1 ~ 11.0, 58.6 ~ 79.6)         COLT/NUT Thin screw         Pitch [mm (in.)]         4T         O.5 (0.019)         2.9 ~ 2.9 (0.3 ~ 0.3, 2.2 ~ 2.2)         2.2)         0.75 (0.029)       3.9 ~ 5.9 (0.4 ~ 0.6, 2.9 ~ 4.3)         1 (0.039)       9.8 ~ 12.7 (1.0 ~ 1.3, 7.2 ~ 9.4)         1 25 (0.049)       19.6 ~ 25.5 (2.0 ~ 2.6,	Pitch [mm (in.)]  4T  8T  0.8 (0.031)  2.0 ~ 2.9 (0.2 ~ 0.3, 1.4 ~ 5.9 ~ 7.8 (0.6 ~ 0.8, 4.3 ~ 2.2)  1 (0.039)  3.9 ~ 4.9 (0.4 ~ 0.5, 2.9 ~ 3.8 ~ 13.7 (1.0 ~ 1.4, 7.2 ~ 10.1)  1.25 (0.049)  8.8 ~ 11.8 (0.9 ~ 1.2, 6.5 ~ 24.5 ~ 32.4 (2.5 ~ 3.3, 18.1 ~ 23.9)  1.5 (0.059)  17.7 ~ 24.5 (1.8 ~ 2.5, 13.0 ~ 18.1)  1.75 (0.068)  2 (0.078)  51.0 ~ 68.6 (5.2 ~ 7.0, 35.4 ~ 48.5)  2 (0.078)  51.0 ~ 68.6 (5.2 ~ 7.0, 35.4 ~ 32.4 (13.8 ~ 13.8 (8.6 ~ 11.6, 62.2 ~ 83.9)  2 (0.078)  79.4 ~ 107.9 (8.1 ~ 11.0, 58.6 ~ 79.6)  10.5 (0.019)  2.9 ~ 2.9 (0.3 ~ 0.3, 2.2 ~ 6.9 ~ 8.8 (0.7 ~ 0.9, 5.1 ~ 6.5)  2 (0.078)  Torque Nm (kg.m, lb-ft)  8  1 (0.039)  3.9 ~ 5.9 (0.4 ~ 0.6, 2.9 ~ 10.8 ~ 14.7 (1.1 ~ 1.5, 8.0 ~ 10.8)  1 (0.039)  9.8 ~ 12.7 (1.0 ~ 1.3, 7.2 ~ 26.5 ~ 35.3 (2.7 ~ 3.6, 9.4)  1.25 (0.049)  1.26 (0.049)  1.26 (0.049)  1.26 (0.049)  1.26 (0.049)  1.27 (0.049)  1.28 (0.049)  51.0 ~ 68.6 (5.2 ~ 7.0, 19.5 ~ 2.6, 5.3)

M12	1.25 (0.049)	35.3 ~ 48.1 (3.6 ~ 4.9, 26.0 ~ 35.4)	94.1 ~ 126.5 (9.6 ~ 12.9, 69.4 ~ 93.3)	138.3 ~ 186.3 (14.1 ~ 19.0, 102.0 ~ 137.4)
M14	1.5 (0.059)	55.9 ~ 75.5 (5.7 ~ 7.7, 41.2 ~ 55.7)	148.1 ~ 200.1 (15.1 ~ 20.4, 109.2 ~ 147.6)	216.7 ~ 293.2 (22.1 ~ 29.9, 159.8 ~ 216.3)
M16	1.5 (0.059)	86.3 ~ 116.7 (8.8 ~ 11.9, 63.7 ~ 86.1)	229.5 ~ 309.9 (23.4 ~ 31.6, 169.3 ~ 228.6)	336.4 ~ 455.0 (34.3 ~ 46.4, 248.1 ~ 335.6)

## NOTICE

- 1) The torques shown in the table are standard values under the following conditions.
- · Nuts and bolts are made of galvanized steel bar.
- Galvanized plain steel washers are inserted.
- · All nuts, bolts and plain washers are dry.
- 2) The torques shown in the table are not applicable.
- When spring washers, toothed washers and the like are inserted.
- If plastic parts are fastened.
- If self-tapping screws or self-locking nuts are used.
- If threads and surfaces are coated with oil.

## **IDENTIFICATION NUMBER**



Identification Number Description

**Vehicle Identification Number** 



- 1. World Manufacturer Identifier (WMI)
  - MAL : Passenger vehicle or MPV(Multipurpose Passenger Vehicle)/SUV(Sports Utility Vehicle)/RV(Recreational Vehicle)
  - NLH : Passenger vehicle
  - NLJ : Van
- 2. Vehicle line
  - A: i10
- 3. Model & Series
  - -6: Low grade (L)
  - 7: Middle-Low grade (GL)
  - 8 : Middle grade (GLS, JSL, TAX)
  - 9 : Middle-High grade (HGS)
  - 0 : High grade (TOP)
- 4. Body/Cabin type, Gross Vehicle Weight Rating
  - 5 : Sedan 5 door
- 5. Restraint system, Brake system
  - 1 : Both side Active belt
- 6. Engine type
  - A : Gasoline engine 1.0
  - C: Gasoline engine 1.2
  - B : Bi-Fuel engine 1.0
- 7. Check digit or Driver's side & Transmission
  - A: LHD & MT
  - B: LHD & AT
  - L: RHD & MT
  - M: RHD & AT
- 8. Production year
  - D: 2013, E: 2014, F: 2015, G: 2016 ...
- 9. Plant of production
  - M : Chennai (India)
  - Z : Izmit (Turkey)
- 10. Vehicle production sequence number
  - 000001 ~ 999999

#### **Paint Code**

Code	Color
FRI	Phantom Black
V3G	Stardust
RYS	Sleek Silver
PJW	Pure White
X2R	Red Passion

W5R	Wine Red
T8G	Baby Elepante
U2W	Sliky Beige
P2A	Sweet Orange
R2U	Montano Sky
X3U	Morning Glory

## **Engine Number**



- 1. Engine fuel
  - G: Gasoline
  - B : Bi-Fuel
- 2. Engine range
  - 3: 4 cycle 3 cylinder
  - 4: 4 cycle 4 cylinder
- 3. Engine development order and capacity
  - LA: Kappa engine, 998cc(Gasoline) / 1197cc (Gasoline) / 1248cc (Gasoline) / 998cc (Bi-Fuel)
- 4. Production year
  - D : 2013, E : 2014, F : 2015, G : 2016 ...
- 5. Plant of production
  - A: Asan (Korea)
  - B : Beijing (China)
  - H: Hwasung (Korea)
  - K : Montgomery (U.S.A)
  - M : Chennai (India)
  - P : Poseung (Korea)
  - S : Sohari (Korea)
  - T : Izmit (Turkey)
  - U: Ulsan (Korea)
  - W : Shandong (China)
  - Z : Zilina (Slovakia)
  - 1 : Yancheng (China)
- 6. Transaxle production sequence number
  - 000001 ~ 999999

### Transaxle Number

## Manual (M5EF2)



- 1. Model
  - M : M5EF2
- 2. Production year
  - D: 2013, E: 2014, F: 2015, G: 2016 ...
- 3. Final gear ratio
  - 1671 : 4.437 (Kappa 1.0/1.2)
  - 1471 : 5.071 (Kappa 1.0)
  - 1569 : 4.600 (Kappa 1.2)
- 4. Transaxle production sequence number
  - 000001 ~ 999999

### **Automatic**



- 1. Model
  - E: A4CF0
- 2. Production year
  - D: 2013, E: 2014, F: 2015, G: 2016 ...
- 3. Final gear ratio
  - 5:4.587
  - -8:4.846
  - -4:5.104
- 4. Detailed classification
  - EM : Kappa 1.25 (Europe)
  - EM : Kappa 1.25 (Euroep+ACS)
  - EQ: Kappa 1.0 (Europe)
  - ES: Kappa 1.25 (Europe+ASSS)
  - ET : Kappa 1.0(Europe+ASS)
  - ET : Kappa 1.0(Europe+ASSS)
- 5. Spare
- 6. Transaxle production sequence number
  - 000001 ~ 999999

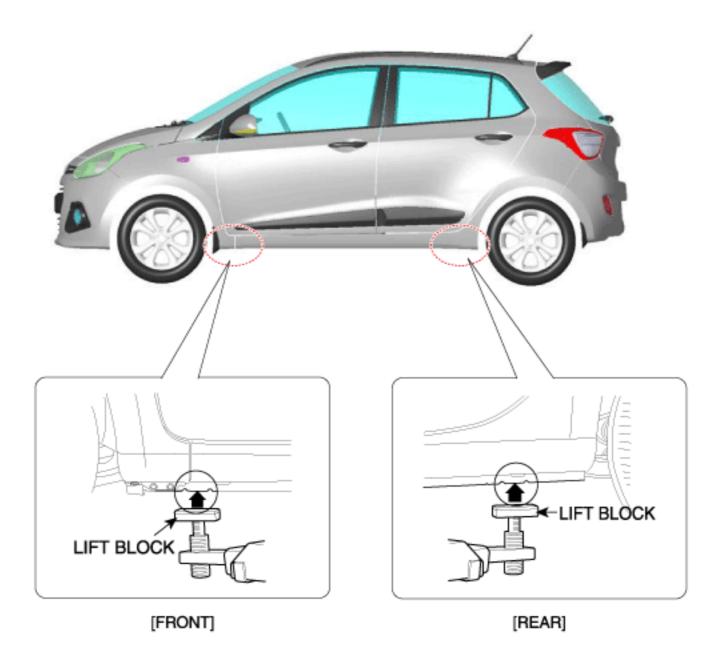
### **LIFT AND SUPPORT POINTS**

## **AWARNING**

When heavy rear components such as suspension, fuel tank, spare tire, tailgate and trunk lid are to be removed, place additional weight in the luggage area before hoisting. When substantial weight is removed from the rear of the vehicle, the center of gravity may change and can cause the vehicle to tip forward on the hoist.

## **NOTICE**

- Since each tire/wheel assembly weights approximately 30lbs (14kg), placing the front wheels in the luggage area can assist with the weight distribution.
- Use the same support points to support the vehicle on safety stands.
- 1. Place the lift blocks under the support points as shown in the illustration.
- 2. Raise the hoist a few inches (centimeters) and rock the vehicle to be sure it is firmly supported.
- 3. Raise the hoist to full height to inspect the lift points for secure support.



### **TOWING**

If the vehicle needs to be towed, call a professional towing service. Never tow vehicle with just a rope or chain. It is very dangerous.





### **Emergency Towing**

There are three popular methods of towing a vehicle :

- The operator loads the vehicle on the back of truck. This is best way of transporting the vehicle.
- The tow truck uses two pivoting arms that go under the tires of the driving axle and lift them off the ground. The other two wheels remain on the ground.
- The tow truck uses metal cables with hooks on the ends. These hooks go around parts of the frame or suspension, and the cables lift that end of the vehicle off the ground. The vehicle's suspension and body can be seriously damaged if this method of towing is attempted.

If the vehicle cannot be transported by flat-bed, should be towed with the wheels of the drivig axle off the ground and do the following:

Manual Transmission

- Release the parking brake.
- Shift the transmission to neutral

Automatic Transmission

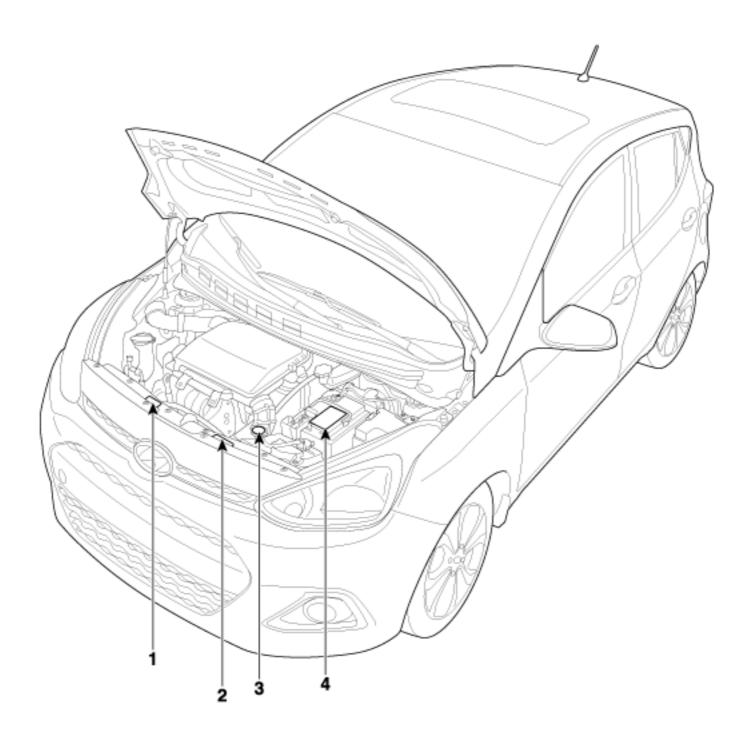
- Release the parking brake.
- · Start the engine.
- Shift to [D] position, then [N] position.
- Turn off the engine.

## **▲** CAUTION

• The vehicle equipped with full-time 4WD should be only transported on a flat-bed.

- Improper towing preparation will damage the transaxle. follow the above procedure exactly. If you cannot shift the transaxle or start the engine(automatic transaxle), your vehicle must be transported on a flatbed.
- It is the best to tow vehicle no farther than 30km (19miles), and keep the speed below 50km/h (30mph). (For the full-time 4WD vehicle, limit the towing to 1.5km (1mile) and 15km/h (10mph)
- Trying to lift or tow your vehicle by the bumpers will cause serious damage. The bumpers are not designed to support the vehicle's weight.

# **WARNING AND CAUTION LABELS**



- 1. Compressor Caution
- 2. Fan Caution

- 3. Radiator Cap Caution
- 4. Battery Caution

**Battery Caution Label Describtion** 



### Warning / Caution Label (Cont'd)

Keep lighted cigarettes and all other flames or sparks away from the battery.

- B. Wear eye protection when charging or working near a battery. Always provide ventilation when working in an enclosed space.
  - When lifting a plastic-cased battery, excesive pressure on acid to leak resulting in personal injury. Lift with a battery carrier or with your hands on opposite corners.
  - Never attempt to change the battery when the battery cables are connected.
  - The electrical ignition system works with high voltage.

    Never touch these components with the engine running or the ignition switched on.

Keep batteries out of the reach of children because batteries contain highly corrosive SULFURIC ACID. Do not allow battery acid to contact your skin, eyes, clothing or paint finish.

D.

If any electrolyte gets into your eyes, flush your eyes with clean water for at least 15 minutes and get immediate medical attention. If possible, continue to apply water with a sponge or cloth until medical attention is received.

If electrolyte gets on your skin, throughly wash the contacted area. If you feel a pain or a burning sensation, get medical attention immediately.

E. Always read the following instructions carefully when handing a battery.

F. Hydrogen, which is a highly combustible gas, is always presents in battery cells and may explode if ignited.

G.

An improperly disposed battery can be harmful to the environment and human health. Always confirm local regurations for battery disposal.

## **Handling and Storage the Battery**

Battery Itself	Batteries should be stored in cool, dry (27 degrees Celsius) places and out of direct sunlight.
	<ul> <li>MF batteries are tightly sealed to prevent acid leakage.     However, tilting the battery to an angle of 45 degrees can cause acid to leak     through the vents on the sides. Therefore, batteries should always be stored in     their upright positions. Prevent placing any aqueous or solid (i.e. conductors)     bodies on top of the battery.</li> </ul>
	It is extremely dangerous to use tools, such as hammers, on the battery terminals when connecting cables to the mounted battery.
Battery on Vehicle	When storing the vehicle for long periods of time, make sure to remove the memory fuse at junction box to prevent natural discharging.
	<ul> <li>Also, run the engine for battery charging within 1 month if the memory fuse wasn't removed from the start of vehicle storing.</li> <li>If the memory fuse was removed, run the engine for battery charging within 3 months from the start of vehicle storing.</li> </ul>

# NOTICE

After reconnecting or recharging a discharged battery, the ESP OFF indicator may illuminate.

In this case, turn the handle half way to the left and right whilst the ignition switch is in the ON position.

Then, restart the engine after the ignition is OFF.

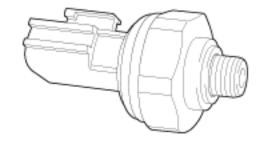
The ESP OFF indicator may turn OFF.

If the ESP OFF indicator does not turn OFF, have the system checked refering to DTC. (Refer to the BR group.)

2016 > G 1.2 MPI > G 1.2 MPI > Heating, Ventilation and Air Conditioning > Air Conditioning System A/C Pressure Transducer > Description and Operation

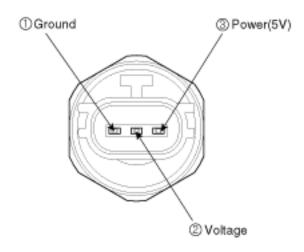
# **DESCRIPTION**

The A/C Pressure Transducer (APT) convert the pressure value of high pressure line into voltage value after measure it. By converted voltage value, engine ECU controls cooling fan by operating it high speed or low speed. Engine ECU stop the operation of compressor when the temperature of refrigerant line is so high or so low irregularly to optimize air conditioning system.

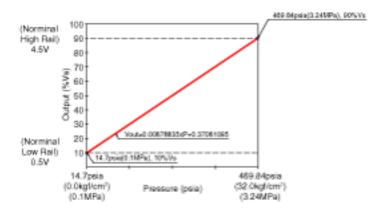


#### **INSPECTION**

1. Measure the pressure of high pressure line by measuring voltage output between terminal "1" and "2".



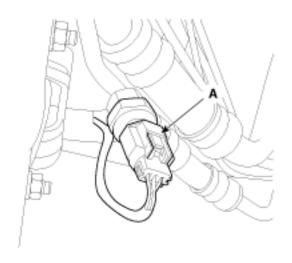
2. Inspect the voltage value whether it is sufficient to be regular value or not.



3. If the measured voltage value is not specification, replace the A/C pressure transducer.

#### REPLACEMENT

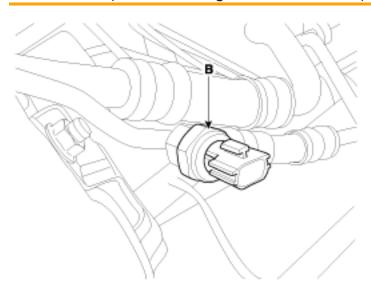
- 1. Disconnect the negative (-) battery terminal.
- 2. Recover the refrigerant with a recovery/charging station.
- 3. Disconnect the A/C pressure transducer connector (A).



4. Remove the A/C pressure transducer (B).

#### **Tightening torque:**

10 ~ 12 N.m (1.02 ~ 1.22 kgf.m, 7.4 ~ 8.8 lb-ft)



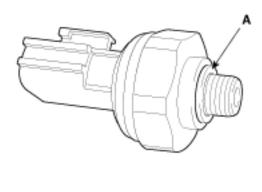
# **▲** CAUTION

Take care that liquid & suction pipe are not bent.

5. Install in the reverse order of removal.

# NOTICE

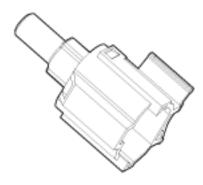
When installing, replace with new O-ring (A).



### **DESCRIPTION**

The ambient temperature sensor is located at the front of the condenser and detects ambient air temperature. It is a negative type thermistor; resistance will increase with lower temperature, and decrease with higher temperature.

The sensor output will be used for discharge temperature control, temperature regulation door control, blower motor level control, mix mode control and in-car humidity control.

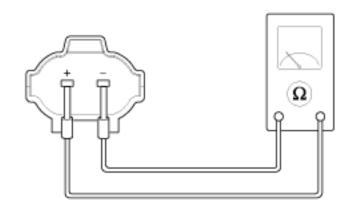


# NOTICE

If the ambient temperature is below 1.0°C (33.8°F), the A/C compressor will be stopped. The compressor will be operated by manual operating.

#### **INSPECTION**

- 1. Turn the ignition switch OFF.
- 2. Disconnect ambient temperature sensor.
- 3. Check the resistance of ambient temperature sensor between terminal "+" and "-" whether it is changed by changing of the ambient temperature.



Temperatrue (°C)	Resistance min. (KΩ)	Resistance mid. (KΩ)	Resistance max. (KΩ)
-40	811.091	881.030	956.784
-30	447.670	480.410	515.428
-20	255.634	271.210	287.671
-10	150.712	158.180	165.981
0	91.533	95.096	98.775
10	57.143	58.799	60.490
20	36.595	37.315	38.040
30	23.795	24.260	24.729
40	15.692	16.130	16.576
50	10.571	10.950	11.341
60	7.236	7.579	7.907
70	5.082	5.341	5.611
80	3.618	3.828	4.049

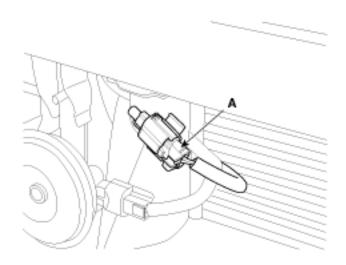
- 4. If the measured resistance is not specification, substitute with a known-good ambient temperature sensor and check for proper operation.
- 5. If the problem is corrected, replace the ambient temperature sensor.

#### **REPLACEMENT**

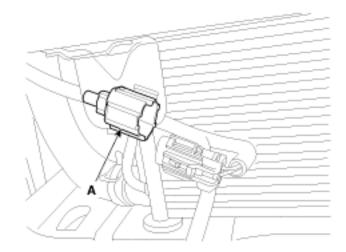
- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the engine room right side under cover.

(Refer to Engine Mechanical System - "Engine and Transmission Assembly")

3. Disconnect the ambient temperature sensor connector (A).



4. Remove the ambient temperature sensor (A).

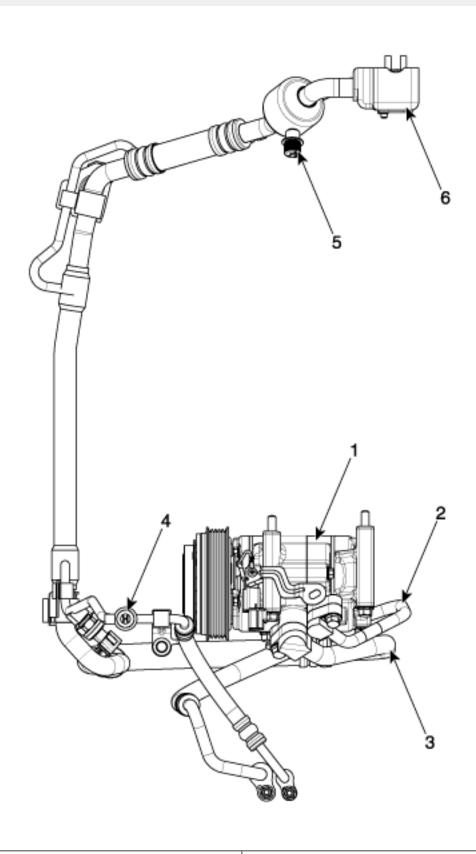


5. Install in the reverse order of removal.

# Air Conditioning System >

# **COMPONENT LOCATION**

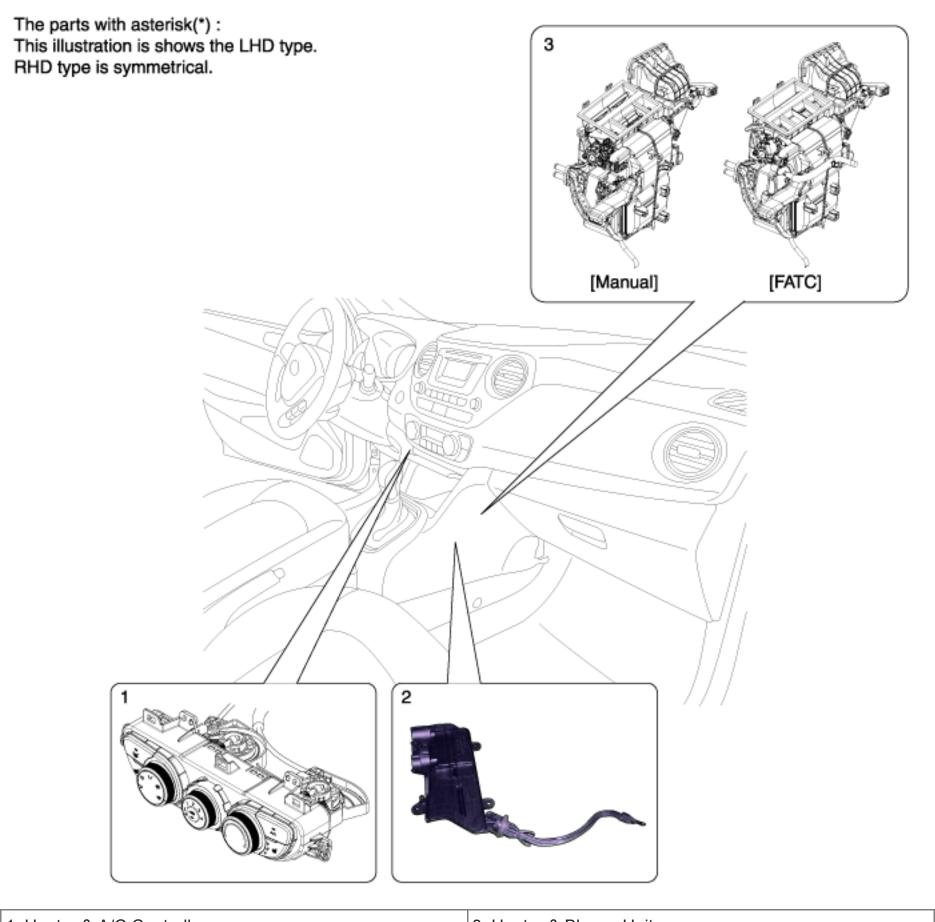
## **Engine Room**



- 1. Compressor
- 2. Discharge hose
- 3. Suction & Liquid Tube Assembly

- 4. Service Port (High)
- 5. Service Port (Low)
- 6. Expansion Valve

Interior

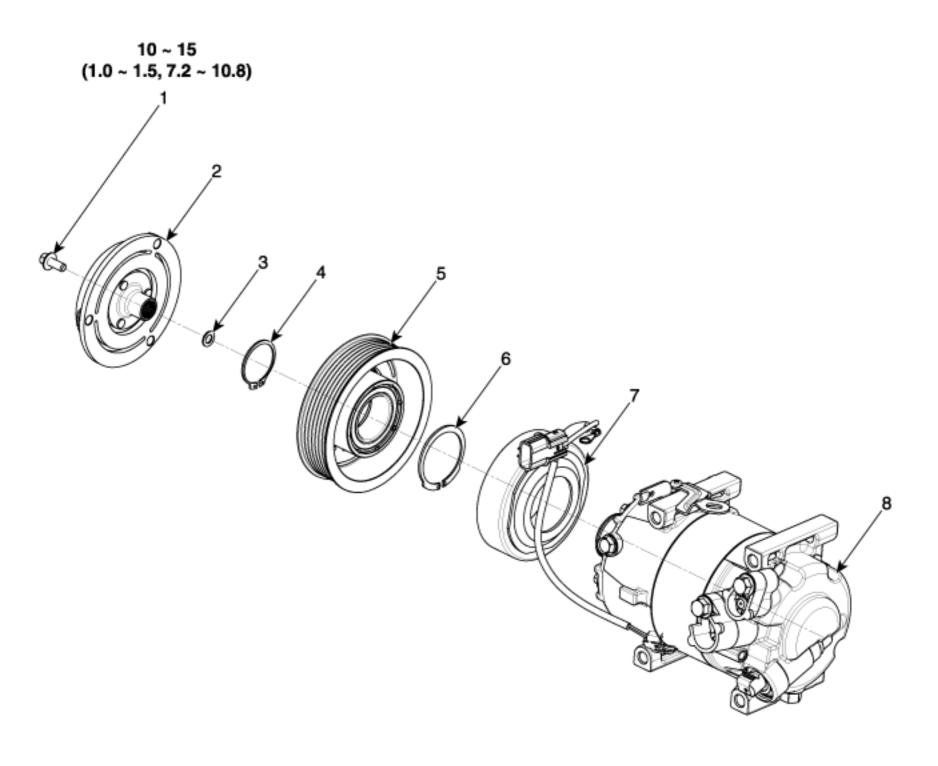


- 1. Heater & A/C Controller
- 2. Evaporator Temperature Sensor

3. Heater & Blower Unit

### **COMPONENTS**

### [External Control Valve Type]

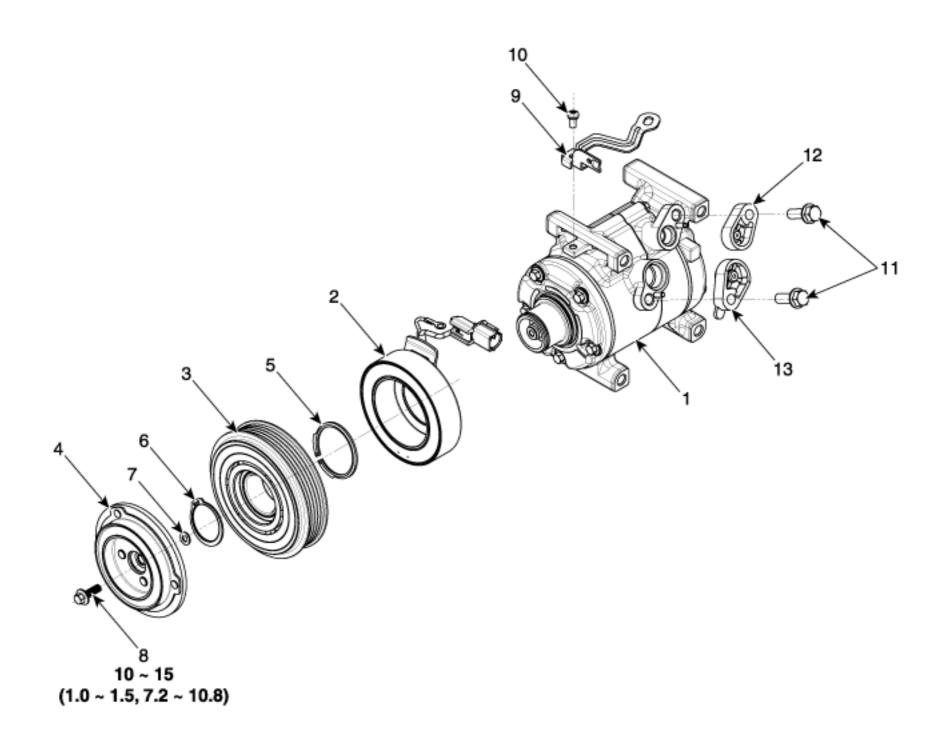


# Tightening Torque: N.m (kgf.m, lb-ft)

1	Cer	nte	r B	olt
- 1	$\sim$ ci	110	-	UIL

- 2. Hub Assembly
- 3. Compressor Spacer
- 4. Ring Retainer (35.0)

- 5. Pulley
- 6. Ring Retainer (45.0)
- 7. Field Coil Assembly
- 8. Compressor Assembly



# Tightening Torque: N.m (kgf.m, lb-ft)

- 1. Compressor Assembly
- 2. Field Coil Assembly
- 3. Pulley Assembly
- 4. Disc & Hub assembly
- 5. Ring Retainer (45.0)
- 6. Ring Retainer (35.0)
- 7. Spacer

- 8. Bolt
- 9. Connector Bracket
- 10. Screw Connector Bracket
- 11. Bolt
- 12. Disc Cap
- 13. Suc Cap

# DESCRIPTION

The compressor is the power unit of the A/C system.

It is located on the side of engine block and driven by a V-belt of engine.

The compressor changes the low pressure and low temperature refrigerant gas into the high pressure and high temperature refrigerant gas.

### Variable Swash Plate Compressor

The compressor has a swash plate that rotates to reciprocate pistons, which compress refrigerant.

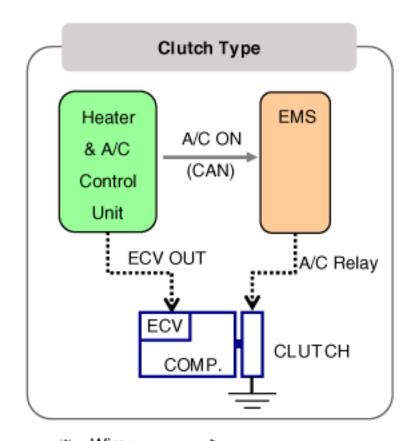
The variable swash plate compressor controls the swash plate angle to change the refrigerant displacement. It achieves precise cooling capability control in accordance with vehicle interior and driving conditions.

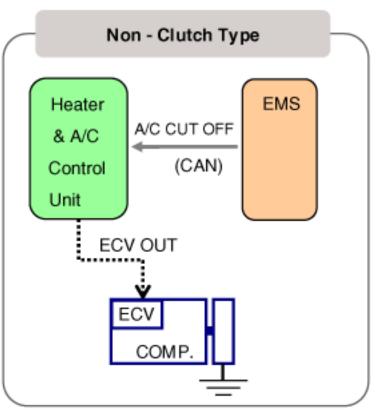
The internally controlled variable swash plate compressor changes the swash plate angle by a MCV (Mechanical Control Valve) in accordance with fluctuation of a suction pressure.

The externally controlled variable swash plate compressor changes the swash plate angle by an ECV (Electric Control Valve) in accordance with an electrical signal from the heater & A/C control unit.

This enables stable temperature control and improved driving feeling.

### **ECV Control Diagram**



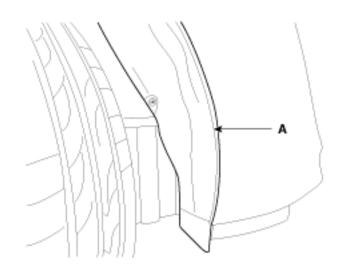


※ Wire: \*\*\*\*\*\*\*

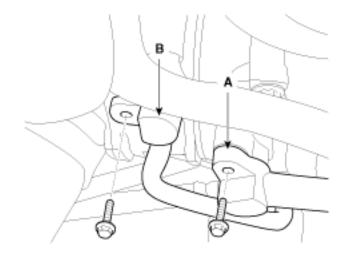
CAN: ----

#### **REMOVAL**

- 1. If the compressor is marginally operable, run the engine at idle speed, and let the air conditioning work for a few minutes, then shut the engine off.
- 2. Disconnect the negative cable from the battery.
- 3. Recover the refrigerant with a recovery/charging station.
- Remove the RH front tire.
   (Refer to Suspension System "Front Wheel & Tire")
- Remove the engine room RH side under cover.
   (Refer to Engine Mechanical System "Engine and Transmission Assembly")
- 6. Separate the front portion of the front wheel guard (A) from the wheel house.



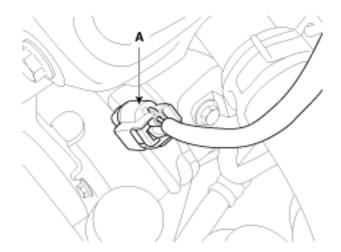
- 7. Loosen the drive belt. (Refer to Engine Mechanical System "Timing Chain")
- 8. Disconnect the suction line (A) and discharge line (B) from the compressor.



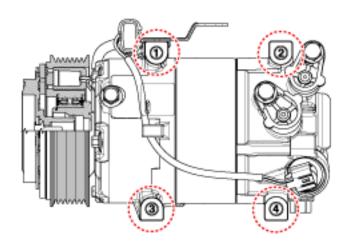
### NOTICE

Plug or cap the lines immediately after disconnecting them to avoid moisture and dust contamination.

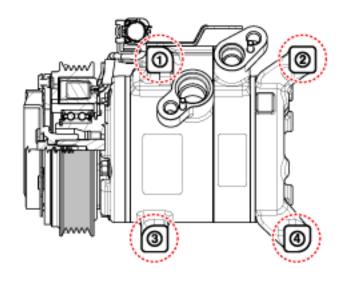
9. Disconnect the compressor switch connector (A).



Remove the compressor by loosening the mounting bolts.[ECV Type]



## [Fixed Type]



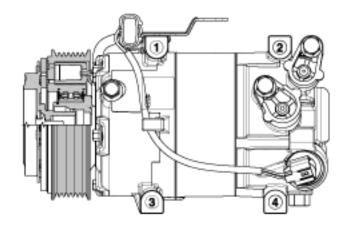
# **INSTALLATION**

1. Make sure of the length of compressor mounting bolts, and then tighten it with the specified tightening order.

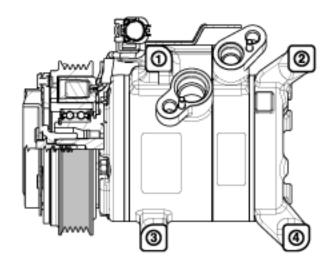
### **Tightening torque:**

19.6 ~ 33.4 N.m (2.0 ~ 3.4 kgf.m, 14.5 ~ 24.6 lb-ft)

[ECV Type]



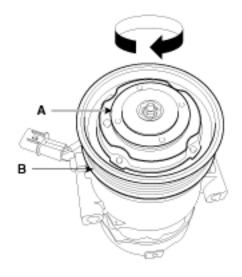
#### [Fixed Type]



- 2. Install in the reverse order of removal.
  - If you install a new compressor, drain all the refrigerant oil from the removed compressor and measure its volume.
     Subtract the volume of drained oil from the original compressor oil capacity (100 cc). The result is the amount of oil you should drain from the new compressor (through the suction fitting)
  - Replace the O-rings with new ones at each fitting, and apply a thin coat of refrigerant oil before installing them. Be sure to use the right O-rings for R-134a to avoid leakage.
  - To avoid contamination, do not return the oil to the container once dispensed, and never mix it with other refrigerant oils.
  - Immediately after using the oil, replace the cap on the container and seal it to avoid moisture absorption.

#### **INSPECTION**

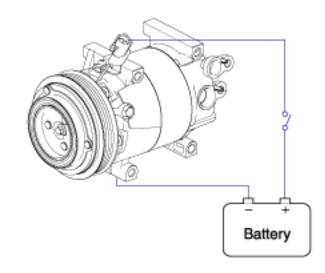
- 1. Check the plated parts of the disc & hub assembly (A) for color changes, peeling or other damage. If there is damage, replace the clutch set.
- 2. Check the pulley (B) bearing play and drag by rotating the pulley by hand. Replace the clutch set with a new one if it is noisy or has excessive play/drag.



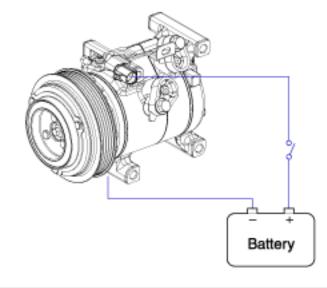
3. Check operation of the magnetic clutch.

Connect the compressor side terminals to the battery (+) terminal and the ground battery (-) terminal to the compressor body. Check the magnetic clutch operating noise to determine the condition.

### [ECV Type]



### [Fixed Type]



### **External Control Valve (ECV) Compressor Inspection (GDS)**

Compressor type: Fixed type compressor, External control valve, Internal control valve.

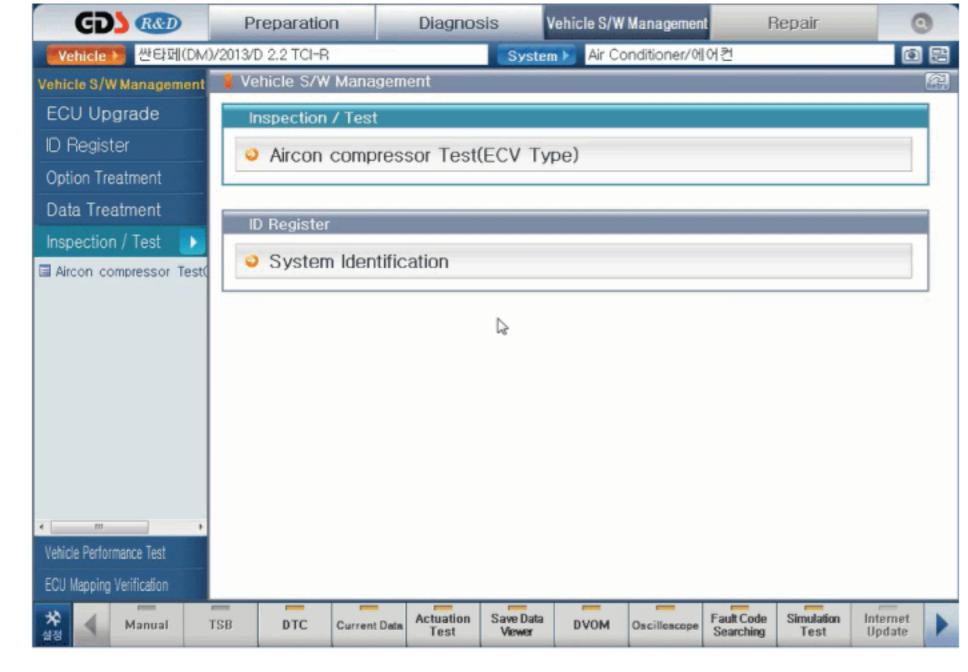
In cases of fixed type and internal control valve, it is possible to inspect compressor's operation with clutch noise.

When it comes to External control valve, however, it cannot be checked in this way bacause it doesn't have a clutch.

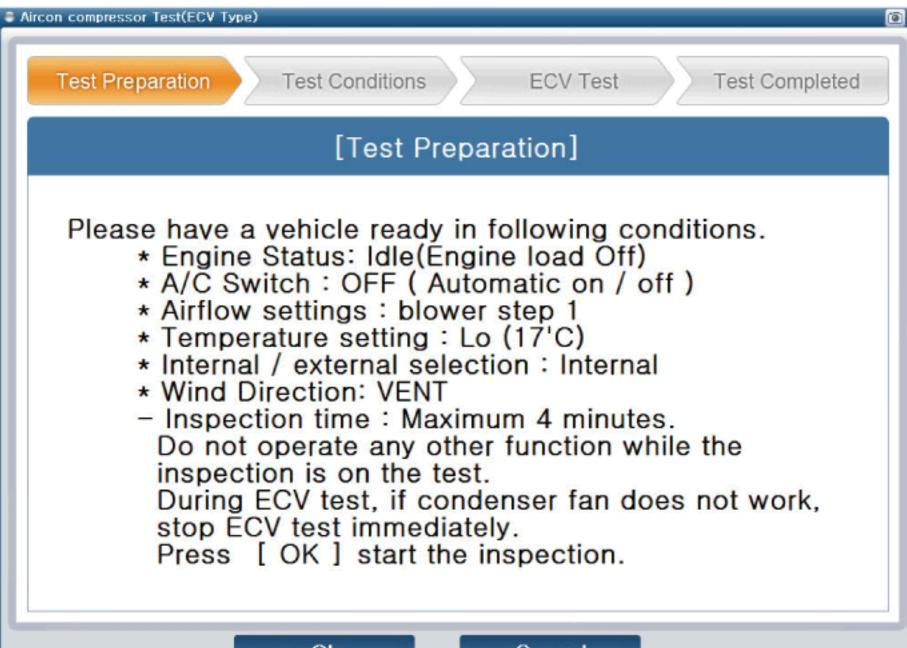
So, ECV should be inspected with GDS as below.

1. Connect GDS to the vehicle and select 'Aircon Compressor Test(ECV type)'.

### [ECV1]



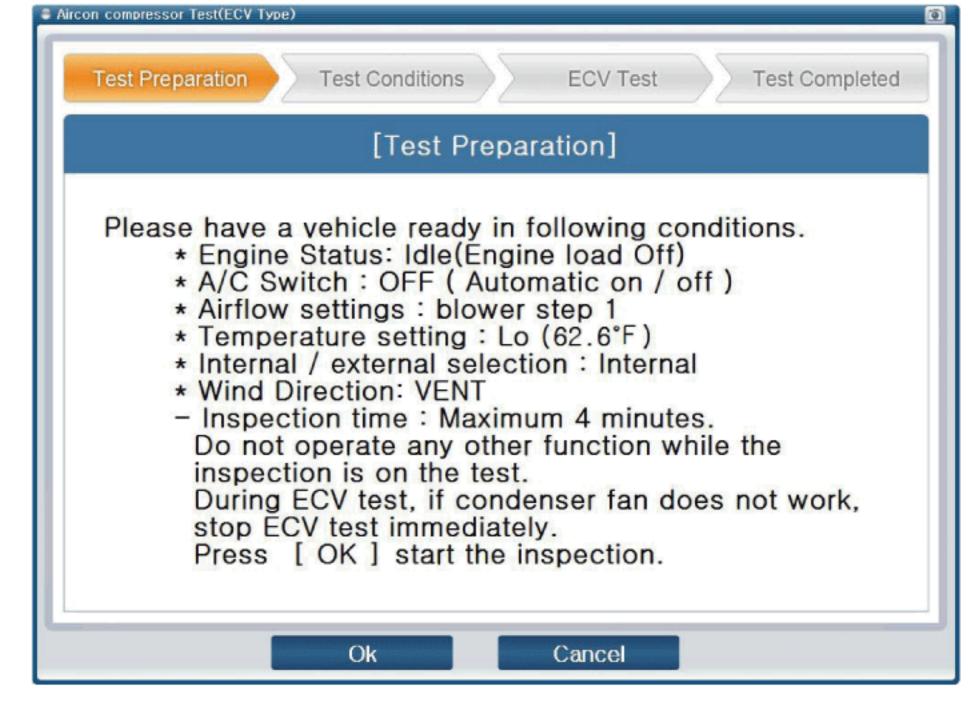
2. Make the vehicle ready as the GDS instruction on the monitor (Turn off A/C 'switch' only). **[ECV2]** 



Ok

Cancel

[ECV3]

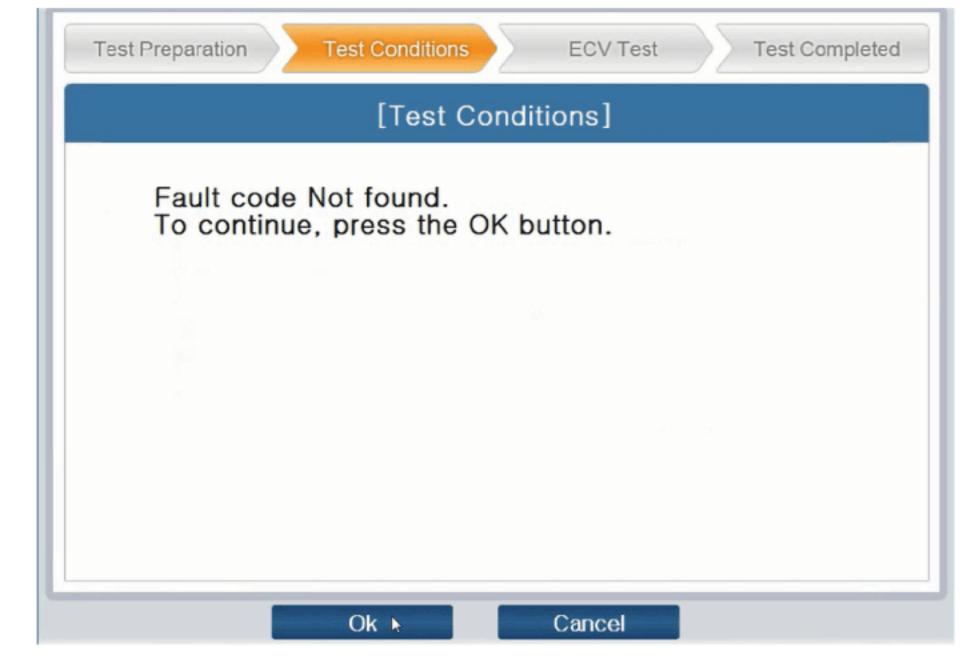


3. Check if other DTC codes are found before inspect ECV compressor. If so, solve that problems first. If not, press 'OK' button to continue.

1 Information

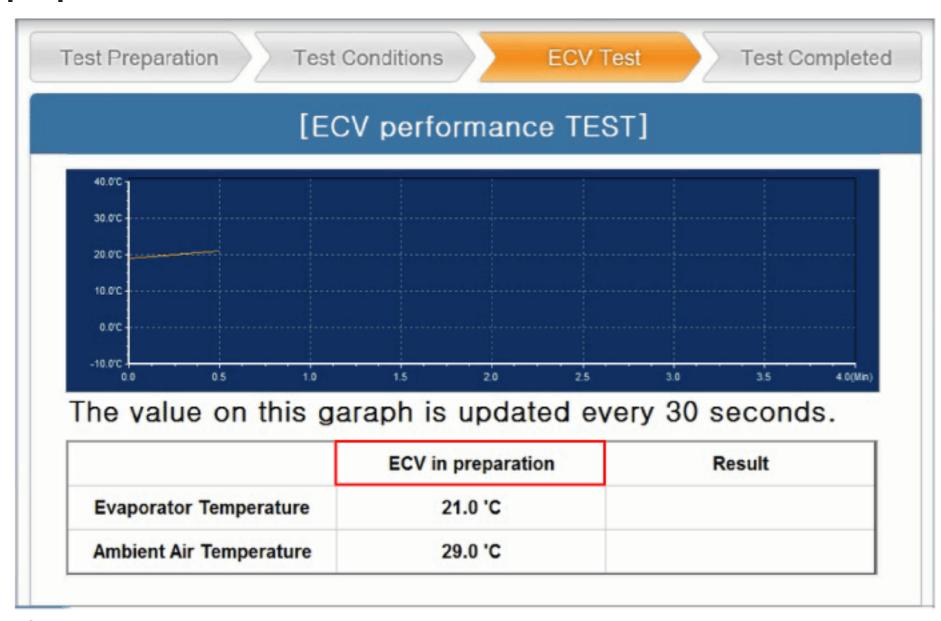
Do not continue inspection if these DTC codes are found: B1241, B1242, B1672, B1685, B1686, B1687

[ECV4]



4. Start inspection.

[ECV5]



The value on this garaph is updated every 30 seconds.

	ECV in preparation	Result
Evaporator Temperature	75.0 'F	
Ambient Air Temperature	85.0 'F	

# **▲** CAUTION

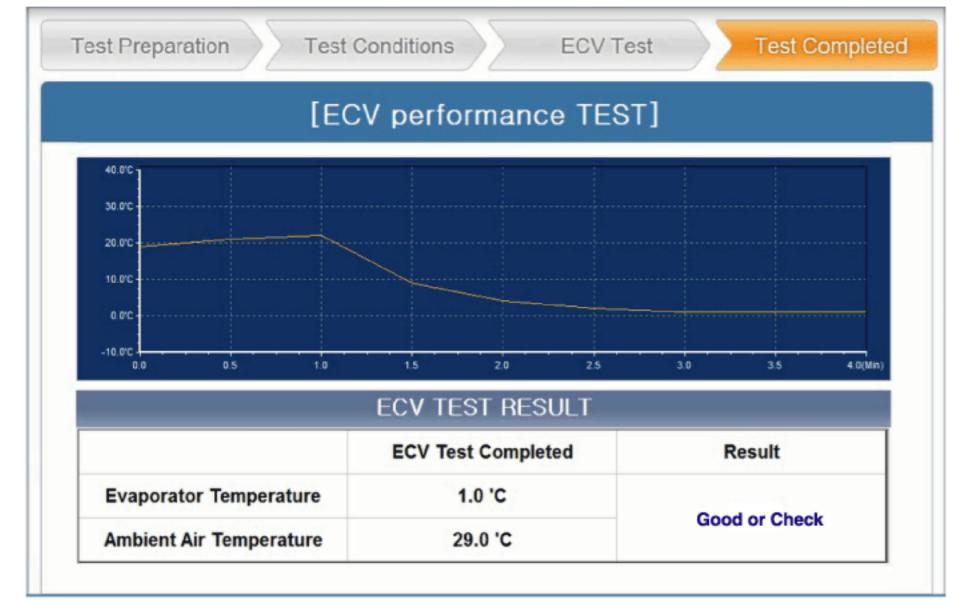
Check if condenser fan is operating when condition is changed to 'ECV running'.

# **▲** CAUTION

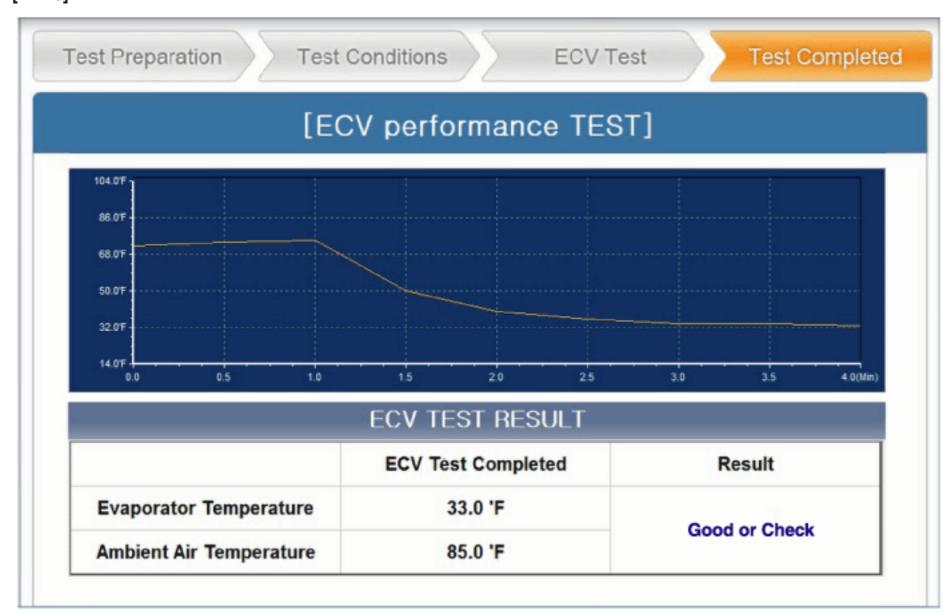
Relife valve will be operated if a condenser fan doesn't work because of overpressure in the compressor. It helps the airconditiong system to relieve by releasing refrigerant and oil. (Closed if relieved)

- \* Refill refrigerant and oil after operation of Relife valve
- \* Noise occurred when Relife vlave is in operation
- 5. Check the result of inspection and click 'Check Detail' if it's 'Check'. Follow the instruction and inspect ECV again from the first step.

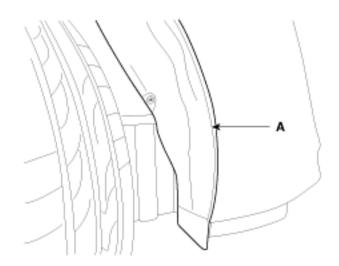
[ECV7]



[ECV8]



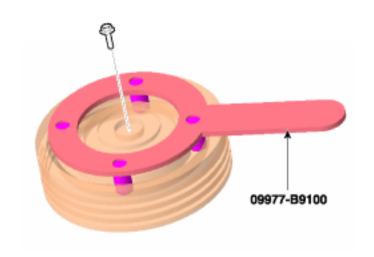
- Remove the right side front tire.
   (Refer to Suspension System "Tire Wear")
- Remove the engine room RH side under cover.(Refer to Engine Mechanical System "Engine and Transmission Assembly")
- 3. Separate the front portion of the front wheel guard (A) from the wheel house.



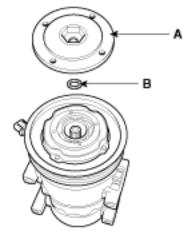
- Loosen the drive belt.
   (Refer to Engine Mechanical System "Timing Chain")
- 5. Remove the center bolt (A) and the hub bolts (B) while holding the pulley with a disc & hub assembly bolt remover (09977-B9100).

### **Tightening torque:**

15 ~ 21 N.m (1.5 ~ 2.1 kgf.m, 11.1 ~ 15.5 lb-ft)



6. Remove the hub assembly (A) and shim (gap washer) (B), taking care not to lose the shim.

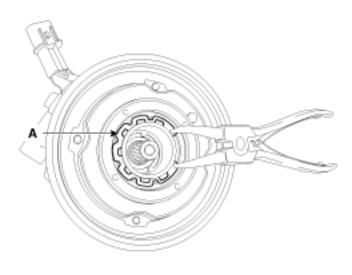


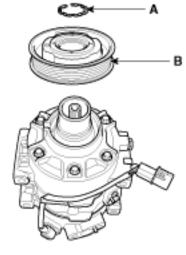
7. Remove the pulley (B) after removing the snap ring (A) with snap ring pliers.

### NOTICE

• Be careful not to damage the pulley and compressor during disassembly/reassembly.

• Once snap ring is removed, replace it with a new one.





8. Reassembly is the reverse order of disassembly.

# NOTICE

- Clean the pulley and compressor sliding surfaces with non-petroleum solvent.
- Install new snap ring, and make sure they are fully seated in the groove.
- Make sure that the pulley turns smoothly after reassembly.

#### **OIL SPECIFICATION**

- 1. The R134-a and R-1234yf system requires synthetic compressor oil (PAG) whereas the R-12 system requires mineral compressor oil. The two oils must never be mixed.
- 2. Compressor oil (PAG) varies according to compressor model. Be sure to use oil specified for the model of compressor.

#### **Handling of Oil**

- 1. The oil should be free from moisture, dust, metal powder, etc.
- 2. Do not mix with other oil.
- 3. The water content in the oil increases when exposed to the air. After use, seal oil from air immediately. (R134-a and R-1234yf compressor oil absorbs moisture very easily.)
- 4. The compressor oil must be stored in steel containers, not in plastic containers.

#### **Compressor Oil Check**

The oil used to lubricate the compressor is circulating with the refrigerant.

Whenever replacing any component of the system or a large amount of gas leakage occurs, add oil to maintain the original amount of oil.

### Oil total volume in system

#### **PAG OIL**

External Control Valve type:  $100 \pm 10g (3.52 \pm 0.35oz.)$ 

Fixed type:  $100 \pm 15g (3.52 \pm 0.52oz.)$ 

#### **Oil Return Operation**

There is close affinity between the oil and the refrigerant.

During normal operation, part of the oil recirculation with the refrigerant in the system. When checking the amount of oil in the system, or replacing any component of the system, the compressor must be run in advance for oil return operation. The procedure is as follows:

- 1. Open all the doors and the engine hood.
- 2. Start the engine and air conditioning switch to "ON" and set the blower motor control knob at its highest position.
- 3. Run the compressor for more than 20 minutes between 800 and 1,000 rpm in order to operate the system.
- 4. Stop the engine.

### **INSPECTION**

- 1. Check the condenser fins for clogging and damage. If clogged, clean them with water, and blow them with compressed air. If bent, gently bend them using a screwdriver or pliers.
- 2. Check the condenser connections for leakage, and repair or replace it, if required.

#### **REPLACEMENT**

- 1. Recover the refrigerant with a recovery/recycling/charging station.
- 2. Disconnect the negative (-) battery terminal.
- Remove the front bumper.(Refer to Body "Front Bumper")
- 4. Remove Radiator upper bracket.

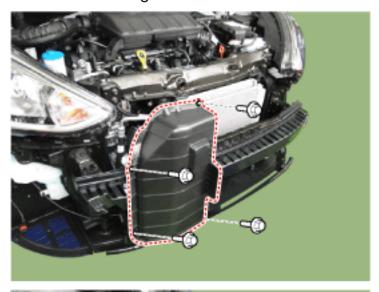


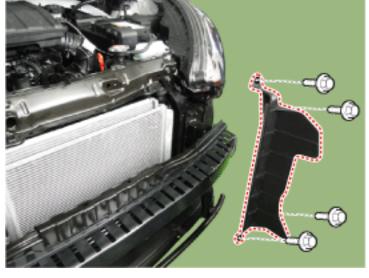


5. Remove upper air guard.

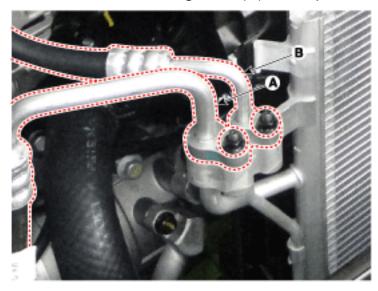


6. Remove side air guards.

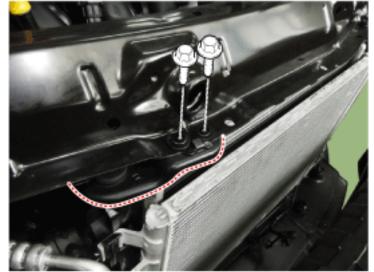




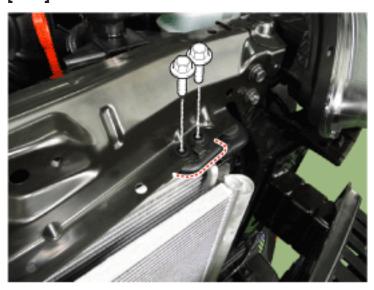
7. Disconnect the discharge line (A) and liquid line (B) from the condencer.



8. Loosen the mounting bolts. **[Right]** 



[Left]



9. Remove the condenser (A) from the radiator

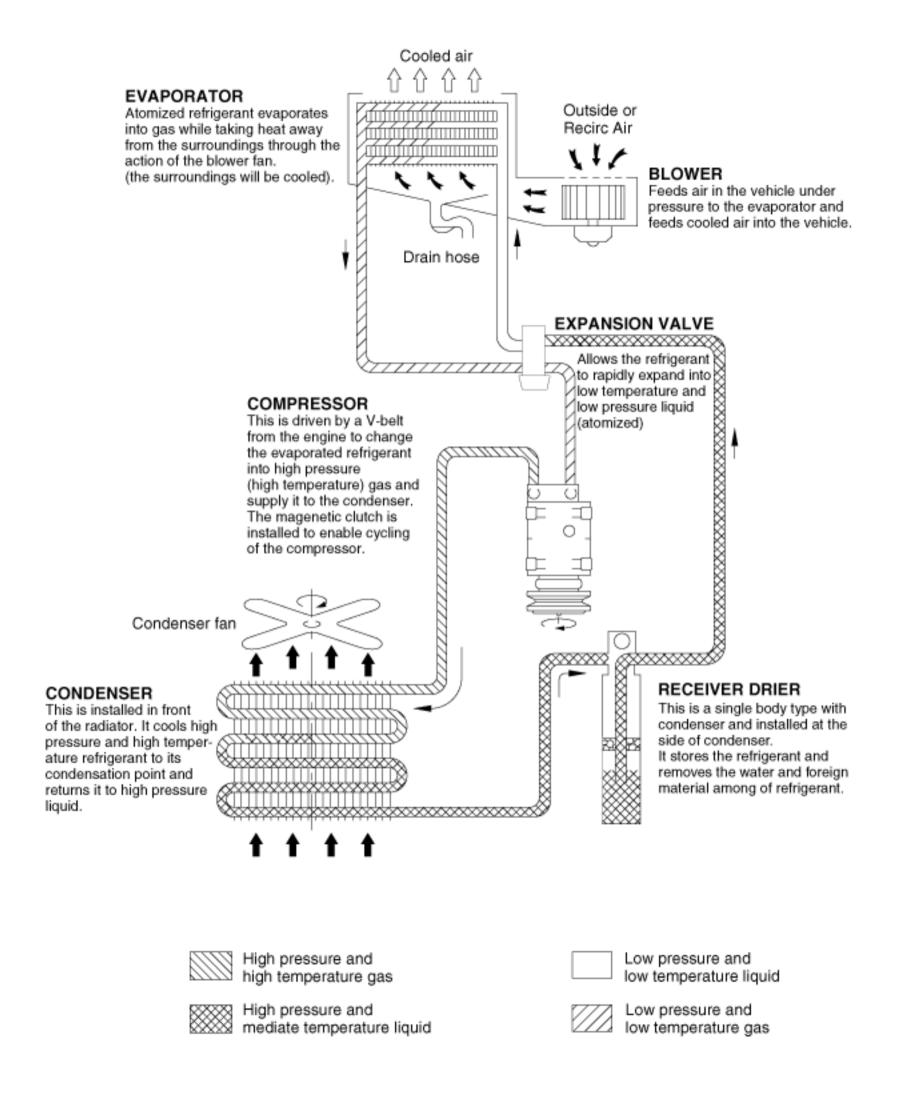


10. Install in the reverse order of removal.

# NOTICE

- If you're installing a new condenser, add refrigerant oil.
- Replace the O-rings with new ones at each fitting, and apply a thin coat of refrigerant oil before installing them. Be sure to use the right O-rings for R-134a to avoid leakage.
- Be careful not to damage the radiator and condenser fins when installing the condenser.
- Charge the system, and test its performance.

#### REFRIGERATION CYCLE



2016 > G 1.2 MPI > G 1.2 MPI > Heating, Ventilation and Air Conditioning > Air Conditioning System > Evaporator Temperature Sensor > Description and Operation

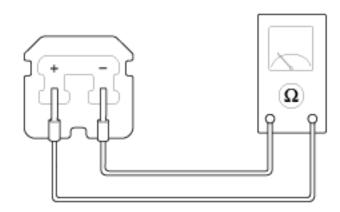
# **DESCRIPTION**

The evaporator temperature sensor will detect the evaporator core temperature and interrupt compressor relay power in order to prevent evaporator freezing by excessive cooling.



### **INSPECTION**

- 1. Turn the ignition switch OFF.
- 2. Disconnect the evaporator temperature sensor connector.
- 3. Measure resistance between terminal "+" and "-" of evaporator temperature sensor.



- 4. Connect the evaporator temperature sensor connector.
- 5. Run the engine and turn the A/C switch ON, then measure the voltage between the terminals of harness connector.

### **Specification**

Evaporator Core Temperature [°C (°F)]	Resistance [kΩ]
-10	43.35
0	27.62
10	18.07
20	12.11
30	8.30
40	5.81

### **REPLACEMENT**

- 1. Disconnect the negative (-) battery terminal.
- 2. Disconnect the evaporator temperature sensor connector (A).



3. Remove the evaporator temperature sensor (B) by pulling it out.



4. Install in the reverse order of removal.

### **INSTRUCTIONS (R-1234A)**

### When Handling Refrigerant

- 1. R-134a liquid refrigerant is highly volatile. A drop on the skin of your hand could result in localized frostbite. When handling the refrigerant, be sure to wear gloves.
- 2. It is standard practice to wear goggles or glasses to protect your eyes, and gloves to protect your hands. If the refrigerant splashes into your eyes, wash them with clean water immediately.
- 3. The R-134a container is highly pressurized. Never leave it in a hot place, and check storage temperature is below 52°C (126°F).
- 4. An electronic leak detector should be used to check the system for refrigerant leakage. Bear in mind that the R-134a, upon coming into contact with flame, produces phosgene, a highly toxic gas.
- 5. Use only recommended lubricant for R-134a systems. If lubricants other than the recommended one used, system failure may occur.
- 6. PAG lubricant absorbs moisture from the atmosphere at a rapid rate, therefore the following precautions must be observed:
  - When removing refrigerant components from a vehicle, cap the components immediately to prevent entry of
    moisture.
  - When installing refrigerant components to a vehicle, do not remove the cap until just before connecting the components.
  - Complete the connection of all refrigerant tubes and hoses without delay to prevent the A/C system from taking on moisture.
  - Use the recommended lubricant from a sealed container only.
- 7. If an accidental discharge in the system occurs, ventilate the work area before resume of service.

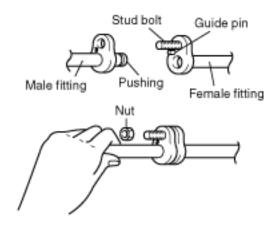
## When Replacing Parts On A/C System

- 1. Never open or loosen a connection before discharging the system.
- 2. Seal the open fittings of components with a cap or plug immediately to prevent intrusion of moisture or dust.
- 3. Do not remove the sealing caps from a replacement component until it is ready to be installed.
- 4. Before connecting an open fitting, always install a new sealing ring. Coat the fitting and seal with refrigerant oil before making the connection.

# When Installing Connecting Parts

### Flange With Guide Pin

Check the new O-ring for damage (use only the specified) and lubricate by using compressor oil. Tighten the nut to specified torque.



### **Handling Tubing And Fittings**

The internal parts of the refrigeration system will remain in a state of chemical stability as long as pure moisture-free refrigerant and refrigerant oil are used. Abnormal amounts of dirt, moisture or air can upset the chemical stability and cause problems or serious damage.

### The Following Precautions Must Be Observed

- 1. When it is necessary to open the refrigeration system, have everything you will need to service the system ready so the system will not be left open any longer than necessary.
- 2. Cap or plug all lines and fittings as soon as they are opened to prevent the entrance of dirt and moisture.
- 3. All lines and components in parts stock should be capped or sealed until they are ready to be used.
- 4. Never attempt to rebind formed lines to fit. Use the correct line for the installation you are servicing.
- 5. All tools, including the refrigerant dispensing manifold, the gauge set manifold and test hoses, should be kept clean and dry.

#### **INSTRUCTIONS (R-1234YF)**

## **▲** WARNING

- The R-1234yf liquid refrigerant is a flammable gas. The gas reduces oxygen available for breathing and causes asphyxiation in high concentrations. The victim will not realize that he/she is suffocating.
- Inhalation may cause central nervous system effects and may cause drowsiness and dizziness.
- Ingestion may cause gastrointestinal discomfort. It may cause skin irritation, eye irritation and respiratory tract irritation. Do not breathe vapour. Avoid contact with skin, eyes and clothing.

# **▲** CAUTION

In case of emergency, the following precautions must be observed; First aider needs to protect himself. Take off all contaminated clothing immediately.

- Inhalation: Move to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
   Use oxygen as required, provided a qualified operator is present. Call a physician.
- Skin contact: After contact with skin, wash immediately with plenty of water. Rapid evaporation of the liquid may cause frostbite. If there is evidence of frostbite, bathe (do not rub) with lukewarm (not hot) water. If water is not available, cover with a clean, soft cloth or similar covering. Call a physician. Wash contaminated clothing before re-use.
- Eye contact: Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. In case of frostbite water should be lukewarm, not hot. Call a physician.

 Ingestion: Unlikely route of exposure. As this product is a gas, refer to the inhalation section. Do not induce vomiting without medical advice. If conscious, drink plenty of water. Never give anything by mouth to an unconscious person. Call a physician immediately.

### **▲** CAUTION

When handling refrigerant, the following precautions must be observed:

- Handle with care.
- Wear personal protective equipment.
- Do not breathe vapour.
- Avoid contact with skin, eyes and clothing.
- Ensure that eyewash stations and safety showers are close to the workstation location.
- Use only in well-ventilated areas.
- Protect from sunlight and do not expose to temperatures exceeding 52°C (125°F).
- Follow all standard safety precautions for handling and use of compressed gas cylinders.
- Use authorized cylinders only.
- Protect cylinders from physical damage.
- Do not puncture or drop cylinders, expose them to open flame or excessive heat.
- Do not remove screw cap until immediately ready for use.
- Always replace cap after use.
- Container is hazardous when empty.
- Prevent the creation of flammable or explosive concentrations of vapour in air and avoid vapour concentration higher than the occupational exposure limits.
- Keep product and empty container away from heat and sources of ignition.
- Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.
- Take measures to prevent the build up of electrostatic charge.
- Electrical equipment should be protected to the appropriate standard.
- Use explosion-proof equipment.
- No sparking tools should be used.
- No smoking.

### **▲** CAUTION

- When storing the refrigerant, the following precautions must be observed :
- Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 52°C (125°F). Do not pierce or burn, even after use.
- Keep containers tightly closed in a dry, cool and well-ventilated place.
- Keep away from heat and sources of ignition.
- Storage rooms must be properly ventilated.
- Ensure adequate ventilation, especially in confined areas.
- Protect cylinders from physical damage.
- Store away from incompatible substances.

Store in original container.

### **AWARNING**

- Un-controlled release of R-1234yf refrigerant in the work area may result in high concentrations of R-1234yf that can be flammable. Servicing of R-1234yf systems shall only be done in well ventilated work areas.
- When servicing, maintaining or repairing A/C systems using flammable refrigerants (mildly flammable or higher) the work place shall meet all applicable national, regional or local regulations for work place safety as related to high pressure or flammable gases.

### **▲** CAUTION

- Avoid breathing any refrigerant vapor and lubricant mist. To remove refrigerant from a A/C system, use service
  equipment designed for recovery and removal that is certified to meet the requirements of the appropriate
  SAE Standards.
- Do not increase pressure, in any R-134a, or R-1234yf mobile A/C system with shop air or another refrigerant such as HCFC-22 (R-22) for leak checking, due to potential chemical reactions, flammability of air/R-134a at elevated pressure, contamination of the system, and possible structural damage to the system.
- To prevent an accumulation of refrigerant in case of a major refrigerant leak, open vehicle windows and doors when charging an A/C system
- To prevent accidental release of refrigerant and minimize safety concerns, the installation of any refrigerant service equipment to the vehicle shall only be done with the engine off and after the refrigerant high side pressure has been reduced (approximately 2 to 3 min).

### **▲** CAUTION

- The proper handling procedures should be followed for all refrigerants as designated by the refrigerant manufacturer's Material Safety Data Sheet (MSDS).
- Service personnel shall be aware of the high pressure relief valve location when servicing the vehicle. Service personnel shall not be under the vehicle when charging the refrigerant system due to potential sudden release of the high pressure relief valve.

### When Handling Refrigerant

#### **NOTICE**

- Some of the practices, techniques and procedures, as well as the information, tools and equipment which have been commonly used in mobile air conditioning system diagnosis and service of R-12 and R-134a are different for A/C systems using R-1234yf.
  - Modifications and adjustments have to be made based on the individual characteristics of each refrigerant. No technician may perform service or repair on a mobile air conditioning system using R-1234yf without being trained for the refrigerant being handled. Under the SAE Standard J2845 the refrigerant system should only be serviced by trained and certified technicians to insure proper and safe operation.
- Service technicians should always wear proper personal protective equipment while handling/servicing systems that contain any refrigerant.
- Service technicians shall read and follow the appropriate Material Safety Data Sheets (MSDS), which provide information on safety and the proper personal protective equipment to use.
  - All contact with liquid or gaseous refrigerant shall be avoided.
  - Goggles with side protection and gloves (insulated against heat loss and impermeable to refrigerant) shall be worn while working with the refrigerant circuit.
  - Exposure of the skin to refrigerant may result in frostbite, in which case rub affected area with lukewarm

- water. A physician shall be consulted immediately regarding the affected skin areas.
- A physician shall be consulted immediately in the event of complaints following exposure to high refrigerant concentrations. Complaint symptoms may include: increased breathing rate, breathlessness, headache, accelerated pulse, dizziness.
- Avoid breathing A/C refrigerant and lubricant vapor or mist. To remove refrigerant from the A/C system, use service equipment designed for recovery of that refrigerant which is certified to meet the requirements of the appropriate SAE Standards.
- 1. R-1234yf liquid refrigerant is highly volatile. A drop on the skin of your hand could result in localized frostbite. When handling the refrigerant, be sure to wear gloves.
- 2. It is standard practice to wear goggles or glasses to protect your eyes, and gloves to protect your hands. If the refrigerant splashes into your eyes, wash them with clean water immediately.
- 3. The R-1234yf container is highly pressurized. Never leave it in a hot place, and check storage temperature is below 52°C (125°F).
- 4. An electronic leak detector should be used to check the system for refrigerant leakage. Bear in mind that the R-1234yf, upon coming into contact with flame, produces phosgene, a highly toxic gas.
- 5. Use only recommended lubricant for R-1234yf systems. If lubricants other than the recommended one used, system failure may occur.
- 6. PAG lubricant absorbs moisture from the atmosphere at a rapid rate, therefore the following precautions must be observed :
  - When removing refrigerant components from a vehicle, cap the components immediately to prevent entry of
    moisture.
  - When installing refrigerant components to a vehicle, do not remove the cap until just before connecting the components.
  - Complete the connection of all refrigerant tubes and hoses without delay to prevent the A/C system from taking on moisture.
  - Use the recommended lubricant from a sealed container only.
- 7. If an accidental discharge in the system occurs, ventilate the work area before resume of service.
- 8. Clean all dirt, grease and debris from and around connection joints before servicing and disassembly of refrigerant connections.

2016 > G 1.2 MPI > G 1.2 MPI > Heating, Ventilation and Air Conditioning > Air Conditioning System > In car sensor (FATC only) > Description and Operation

## **DESCRIPTION**

The In-car air temperature sensor is built in the heater & A/C control unit.

The sensor contains a thermistor which measures the temperature of the inside. The signal decided by the resistance value which changes in accordance with perceived inside temperature, is delivered to heater control unit and according to this signal the control unit regulates in-car temperature to intended value.



2016 > G 1.2 MPI > G 1.2 MPI > Heating, Ventilation and Air Conditioning > Air Conditioning System Photo Sensor (FATC only) > Description and Operation

## **DESCRIPTION**

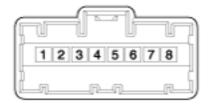
The photo sensor is located at the center of defrost nozzles.

The photo sensor contains a photovoltaic (sensitive to sunlight) diode. The solar radiation received by its light receiving portion, generates an electromotive force in proportion to the amount of radiation received which is transferred to the automatic temperature control module so that the solar radiation compensation will be performed.



#### **INSPECTION**

- 1. Turn the ignition switch ON.
- 2. Connect the GDS.
- 3. Emit intensive light toward photo sensor using a lamp, and check the output voltage change.
- 4. The voltage will rise with higher intensive light and reduce with lower intensive light.



1.	<b>Autolight</b>	Signal

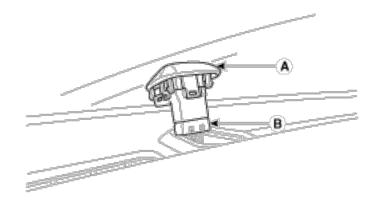
- 2. Autolight Ground
- 3. Photo Signal (Right)
- 4. LED Power (Battery)

5. LED Ground (To BCM)

- 6. Photo Signal (Left)
- 7. Photo Power (Switch)
- 8. Autolight Power (5v)

### REPLACEMENT

- 1. Disconnect the negative (-) battery terminal.
- 2. With a flat-head screwdriver, remove the photo sensor (A) from the center of defrost nozzle after disconnecting the connector (B).

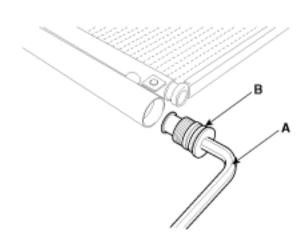


#### **REPLACEMENT**

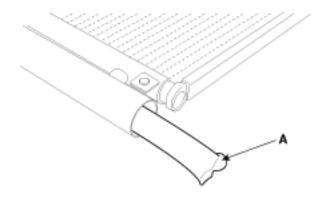
- 1. Remove the condenser.
- 2. Remove the cap (B) on the bottom of the condenser with L wrench (A).

#### **Tightening torque:**

2.7 ~ 3.2 N.m (0.28 ~ 0.33 kgf.m, 2.0 ~ 2.4 lb-ft)



3. Remove the desiccant (A) from condenser using a long nose plier. Check for crumbled desiccant and clogged bottom cap filter.



- 4. Apply air conditioning compressor oil along the O-rings and threads of the new bottom cap.
- 5. Insert the new desiccant into the receiver drier tank. The desiccant must be sealed in vacuum before it is exposed to air for use.
- 6. Install the new bottom cap to the condenser.

#### NOTICE

- Always replace the desiccant and bottom cap at the same time.
- Replace the O-rings with new ones at each fitting, and apply a thin coat of refrigerant oil before installing them. Be sure to use the right O-rings for R-134a to avoid leakage.
- · Be careful not to damage the radiator and condenser fins when installing the condenser.
- Be sure to install the lower mount cushions of condenser securely into the holes.
- Charge the system, and test its performance.

# Air Gonditioning System >

### **REPLACEMENT**

- 1. Discharge refrigerant from refrigeration system.
- 2. Replace faulty tube or hose.

## **▲** CAUTION

Cap the open fittings immediately to keep moisture or dirt out of the system.

3. Tighten joint of bolt or nut to specified torque.

## **▲** CAUTION

Connections should not be torque tighter than the specified torque.

4. Evacuate air in refrigeration system and charge system with refrigerant.

**Specified amount :**  $400 \pm 25g (14.1 \pm 0.88 \text{ oz.})$ 

- Inspect for leakage of refrigerant.Using a gas leak detector, check for leakage of refrigerant.
- 6. Inspect A/C operation.

#### REFRIGERANT SYSTEM SERVICE BASICS

### **Refrigerant Recovery**

Use only service equipment that is U.L-listed and is certified to meet the requirements of SAE J2210 to remove R-134a or R-1234yf from the air conditioning system.

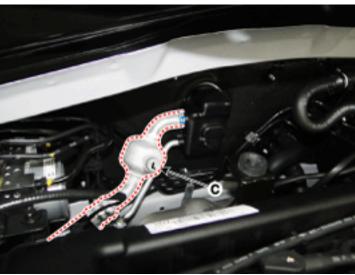
### **▲** CAUTION

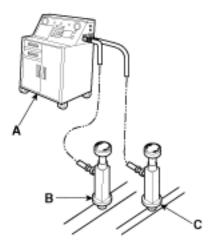
- Air conditioning refrigerant or lubricant vapor can irritate your eyes, nose, or throat.
- Be careful when connecting service equipment.
- Do not breathe refrigerant or vapor.

If accidental system discharge occurs, ventilate work area before resume of service .Additional health and safety information may be obtained from the refrigerant and lubricant manufacturers.

1. Connect an R-134a or R-1234yf refrigerant Recovery/Recycling/Charging System (A) to the high-pressure service port (B) and the low-pressure service port (C) as shown, following the equipment manufacturer's instructions.







2. Measure the amount of refrigerant oil removed from the A/C system after the recovery process is completed. Be sure to install the same amount of new refrigerant oil back into the A/C system before charging.

### System Evacuation

Use only service equipment that is U.L-listed and is certified to meet the requirements of SAE J2210 to remove R-134a or R-1234yf from the air conditioning system.

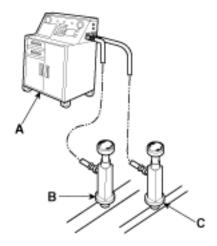
### **▲** CAUTION

- · Air conditioning refrigerant or lubricant vapor can irritate your eyes, nose, or throat.
- Be careful when connecting service equipment.
- Do not breathe refrigerant or vapor.

If accidental system discharge occurs, ventilate work area before resume of service.

Additional health and safety information may be obtained from the refrigerant and lubricant manufacturers.

- 1. When an A/C System has been opened to the atmosphere, such as during installation or repair, it must be evacuated using an R-134a or R-1234yf refrigerant Recovery/Recycling/Charging System. (If the system has been open for several days, the receiver/dryer should be replaced, and the system should be evacuated for several hours.)
- 2. Connect an R-134a or R-1234yf refrigerant Recovery/Recycling/Charging System (A) to the high-pressure service port (B) and the low-pressure service port (C) as shown, following the equipment manufacturer's instructions.



- 3. If the low-pressure does not reach more than 93.3 kPa (700 mmHg, 27.6 in.Hg) in 10 minutes, there is probably a leak in the system. Partially charge the system, and check for leaks (see "Refrigerant Leak Test").
- 4. Remove the low pressure valve from the low-pressure service port.

### **System Charging**

Use only service equipment that is U.L-listed and is certified to meet the requirements of SAE J2210 to remove R-134a or R-1234yf from the air conditioning system.

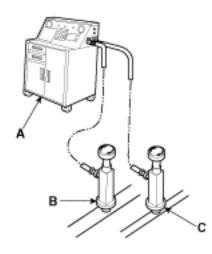
### **▲** CAUTION

- · Air conditioning refrigerant or lubricant vapor can irritate your eyes, nose, or throat.
- Be careful when connecting service equipment.
- · Do not breathe refrigerant or vapor.

If accidental system discharge occurs, ventilate work area before resume of service.

Additional health and safety information may be obtained from the refrigerant and lubricant manufacturers.

Connect an R-134a or R-1234yf refrigerant
 Recovery/Recycling/Charging System (A) to the high-pressure service port (B) as shown, following the equipment manufacturer's instructions.



2. Add the same amount of new refrigerant oil to system that was removed during recovery. Use only specified refrigerant oil. Charge the system with  $400 \pm 25g$  (14.8  $\pm$  0.88 oz.) of R-134a or R-1234yf refrigerant. Do not overcharge the system the compressor will be damaged.

### Refrigerant Leak Test

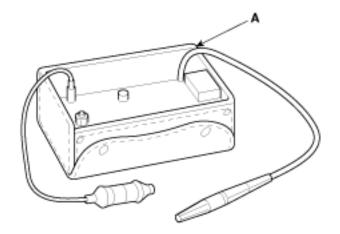
Always conduct a leak test with an electronic leak detector whenever leakage or refrigerant is suspected and when conducting service operations which are accompanied by disassembly or loosening or connection fittings.

#### NOTICE

In order to use the leak detector properly, read the manual supplied by the manufacturer.

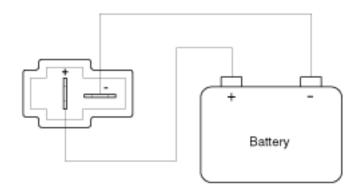
If a gas leak is detected, proceed as follows:

- 1. Check the torque on the connection fittings and, if too loose, tighten to the proper torque. Check for gas leakage with a leak detector (A).
- 2. If leakage continues even after the fitting has been tightened, discharge the refrigerant from the system, disconnect the fittings, and check their seating faces for damage. Always replace, even if the damage is slight.
- 3. Check the compressor oil and add oil if required.
- 4. Charge the system and recheck for gas leaks. If no leaks are found, evacuate and charge the system again.



#### **INSPECTION**

1. Connect the battery voltage and check the blower motor rotation.



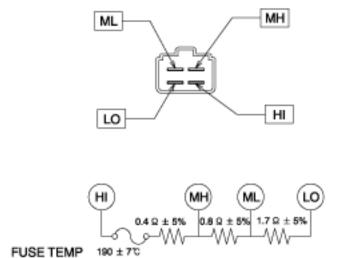
- 2. If the blower motor does not operate well, substitute with a known-good blower motor and check for proper operation.
- 3. If the problem is corrected, replace the blower motor.

#### REPLACEMENT

- 1. Disconnect the negative (-) battery terminal.
- Remove the console assembly. (Refer to Body - "Console")
- Remove the crashpad lowpanel. (Refer to Body - "Crash Pad")
- 4. Remove the driver's side shower duct.
- 5. Remove the blower motor.(Pull the blower motor to the pedal)
- 6. Install in the reverse order of removal.

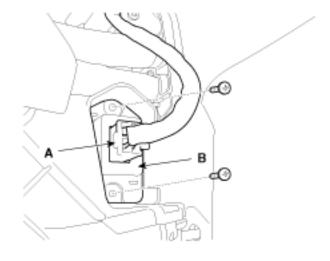
## **INSPECTION**

- 1. Measure the resistance between the terminals.
- 2. The measured resistance is not within specification, the blower resistor must be replaced. (After removing the resistor)

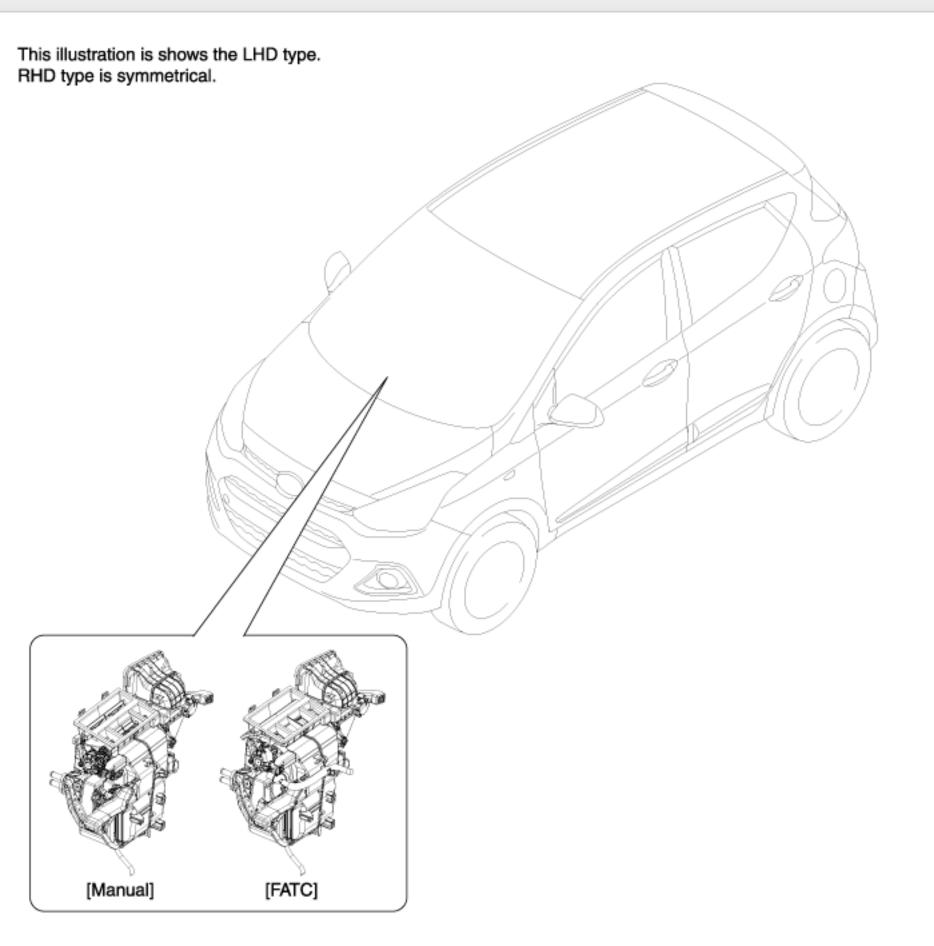


#### **REPLACEMENT**

- 1. Disconnect the negative (-) battery terminal.
- 2. Disconnect the connector (A) and then remove the blower resistor (B) after loosening the mounting screws.

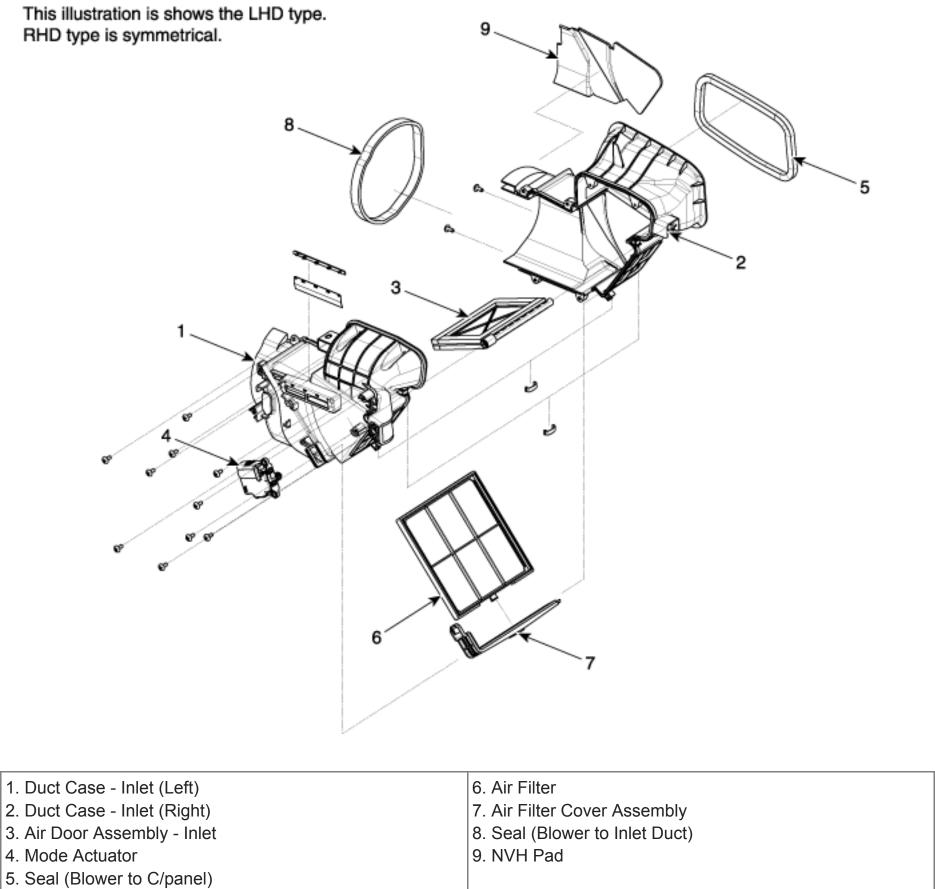


### **COMPONENT LOCATION**



### **COMPONENTS**

[Manual/FATC]



2016 > G 1.2 MPI > G 1.2 MPI > Heating, Ventilation and Air Conditioning > Blower > Climate Control Air Filtar > Description and Operation

## **DESCRIPTION**

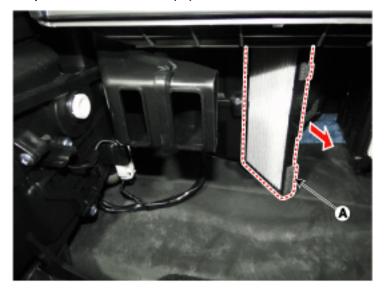
The climate control air filter is located in the bower unit. It eliminates foreign materials and odor. The particle filter performs a role as an odor filter as well as a conventional dust filter to ensure comfortable interior environment.

### **REPLACEMENT**

1. Remove the filter cover (A) by pressing the knob.



2. Replace the air filter (A) with a new one according to the direction of air filter.



## NOTICE

- To remove the filter easily, press the right side inward then pull out the filter.
- In case of driving in an air-polluted area or rugged terrain, check and replace the air filter as frequently as possible.
- 3. Install in the reverse order of removal.

2016 > G 1.2 MPI > G 1.2 MPI > Heating, Ventilation and Air Conditioning > Blower > Intake Actuator > Description and Operation

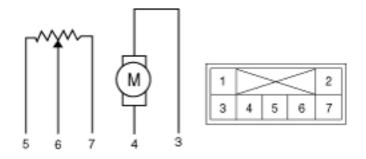
## **DESCRIPTION**

The intake actuator is located at the blower unit. It regulates the intake door by signal from control unit. Pressing the intake selection switch will shift between recirculation and fresh air modes.

#### **INSPECTION**

- 1. Turn the ignition switch OFF.
- 2. Disconnect the intake actuator connector.
- 3. Verify that the intake actuator operates to the fresh (LHD) or recirculation (RHD) position when connecting 12V to the terminal 4 and grounding terminal 3.

Verify that the intake actuator operates to the recirculation (LHD) or fresh (RHD) position when connecting in the reverse.



- 1. -
- 2. -
- 3. Intake Actuator (REC)
- 4. Sensor Ground

- 5. Intake Actuator Feedback
- 6. Sensor REF (5V)
- 7. Intake Actuator (FRE)

- 4. Connect the intake actuator connector.
- 5. Turn the ignition switch ON.
- 6. Check the voltage between terminal 6 and 5 (LHD) or 7 (RHD).

### **Specification**

Door position	Voltage (V)	Error detecting
Fresh	0.5	Low voltage: 0.1V or less
Recirculation	4.5	High voltage: 4.9V or more

- 7. If the intake actuator is not operated well, substitute with a known-good intake actuator and check for proper operation.
- 8. If the problem is corrected, replace the intake actuator.

#### REPLACEMENT

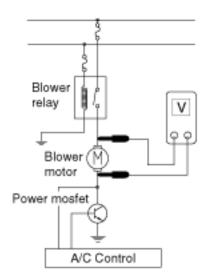
- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the glove box.
- 3. Remove the intake actuator (A) after loosening the mounting screws.





### **INSPECTION**

- 1. Turn the ignition switch ON.
- 2. Manually operate the control switch and measure the voltage of blower motor.
- 3. Select the control switch to raise voltage until high speed.



### **Specification**

•	
Fan Speed (Manual)	Motor Voltage (V)
1	3.75 ± 0.5
2	4.76 ± 0.5
3	6.87 ± 0.5
4	6.99 ± 0.5
5	8.11 ± 0.5
6	9.23 ± 0.5
7	10.63 ± 0.5
8	Battery

\*AUTO COOLING: Auto speed (4.5V~B+)

\*AUTO HEATING: Auto speed (4.5V~10.5V)

- 4. If the measured voltage is not specification, substitute with a known-good power mosfet and check for proper operation.
- 5. If the problem is corrected, replace the power mosfet.

#### REPLACEMENT

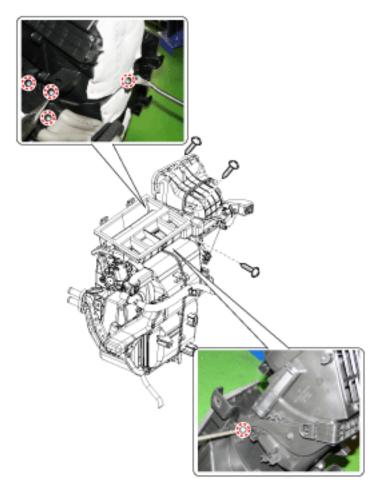
- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the power mosfet (A) after loosening the mounting screws (B).





### **REPLACEMENT**

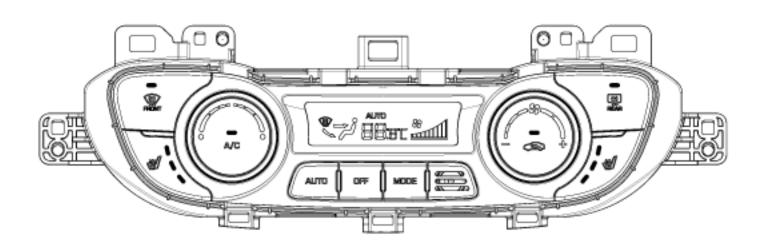
- Remove the heater & blower unit. (Refer to Heater - "Heater Unit")
- 2. Separate the blower unit from the heater unit after loosening the screws.

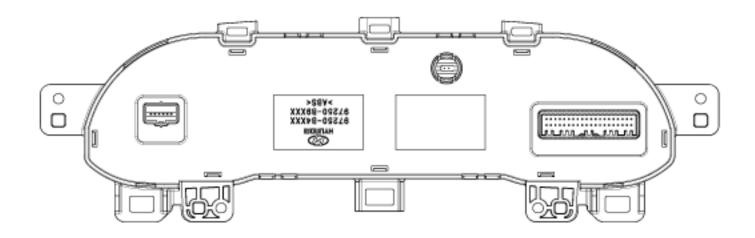


### NOTICE

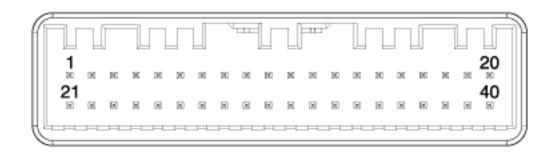
Make sure that there is no air leaking out of the blower and duct joints.

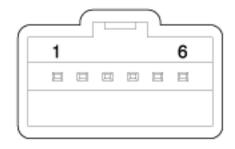






## [Connector]





A B

### **CONNECTOR PIN FUNCTION**

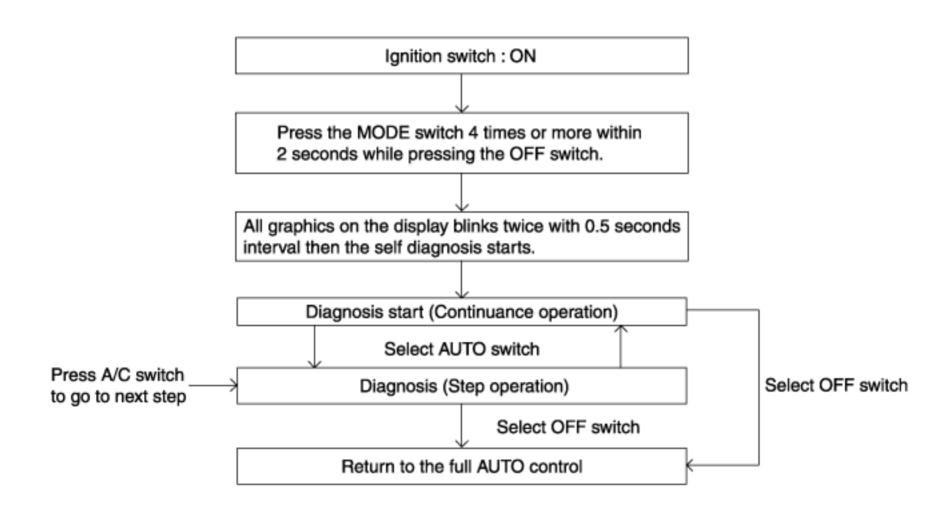
NO	Pin NO.	Pin Name		Pin Name NO Pin NO.	
	1	Battery		24	Photo sensor(-)
	2	ILL+(Tail)		25	Evaporator sensor(+)
	3	-		26	Ambient sensor(+)
	4	HTD		27	K-line

5	Defog		28	Seat heat indicator(LH) - SW
6	Detent out(+)		29	Seat heat indicator(LH) - LOW
7	Mode actuator feedback		30	Seat heat indicator(LH) - MID
8	Temperature actuator feedback		31	Seat heat indicator(LH) - HIGH
9	Intake actuator feedback	A	32	Seat heat indicator(RH) - SW
10	Mode actuator (vent)		33	Seat heat indicator(RH) - LOW
11	Mode actuator defog		34	Seat heat indicator(RH) - MID
12	Temperature actuator cool		35	Seat heat indicator(RH) - HIGH
13	Temperature actuator warm		36	ECV(+)
14	Intake actuator fresh		37	ECV(-)
15	Intake actuator recirculation		38	C CAN HIGH
16	-		39	Sensor ground
17	-		40	Ground
18	_		1	ISG DC
19	ILL-(RHEO)		2	FET(Gate)
20	Sensor ground	В	3	FET(Drain Feedback)
21	IGN1	B	4	Blower motor(+)
22	IGN2		5	-
23	Sensor ref(+5v)		6	-

Α

### **SELF DIAGNOSIS**

#### 1. Self-diagnosis process



2. How to read self-diagnostic code

During the self-diagnosis, the corresponding fault code flickers on the setup temperature display panel every 0.5 second and will show two figures.

Fault codes are displayed in numerical format.

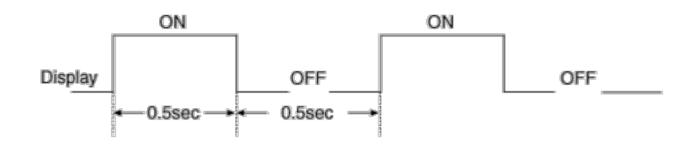
### [FATC]

Display	Fail description
00	Normal
11	In-car sensor open
12	In-car sensor short
13	Ambient temperature sensor open
14	Ambient temperature sensor short
17	Evaporator temperature sensor open
18	Evaporator temperature sensor short
19	Temperature door potentiometer open/short
20	Temperature door potentiometer fault
21	Mode door potentiometer open/short
22	Mode door potentiometer fault
25	Intake door potentiometer open/short

26	Intake door potentiometer fault
45	APT (A/C Pressure Transducer) CAN signal fault
47	RPM CAN signal fault
48	Vehicle speed CAN signal fault
49	Engine coolant temperature CAN signal fault

### 3. Fault code display

(1) Continuance operation: DTC code is none or one.

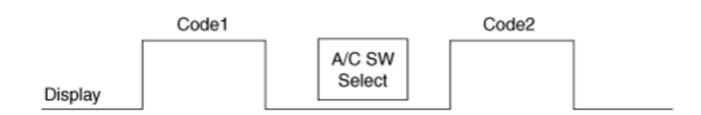


(2) Continuance operation: DTC code is two or more.



### (3) STEP operation

- A. Normal or one fault code is same as a continuance operation.
- B. DTC code is two or more.



4. If fault codes are displayed during the check, inspect malfunction causes by referring to fault codes table.

#### 5. Fail safe

No	Sensor	Fail condition	Fail safe function
1	In-car sensor	< 0.1V or > 4.9V	23°C (73.4°F)
2	Ambient temperature sensor	< 0.1V or > 4.9V	20°C (68°F)
3	Evaporator temperature sensor	< 0.1V or > 4.9V	-2°C (28.4°F)
4	Temperature control actuator feedback	< 0.1V or > 4.9V	<ul> <li>Setting temperature is 24.5°C (76.1°F) or below: Max cool</li> <li>Setting temperature is 25.0°C (77°F) or above: Max hot</li> </ul>
5	Mode control actuator feedback	< 0.5V or > 4.5V	Vent: Vent

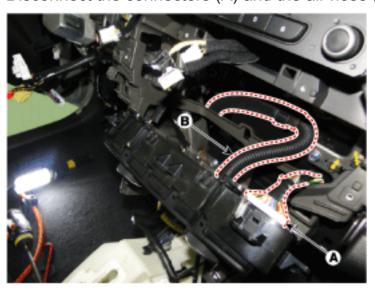
			Others: Defog
6	Intake actuator feedback	< 0.1V or > 4.9V	Recirculation: Recirculation     Others: Fresh
7	Foot actuator feedback	< 0.5V or > 4.5V	<ul><li> Vent: Open</li><li> Others: Close</li></ul>
8	Auto defogging sensor (Relative humidity)	Communication fail	<ul><li>Relative humidity: 60%,</li><li>Surrounding temperature : 23°C (73.4°F)</li></ul>
9	Auto defogging sensor (Glass temperature)	< 0.1V or > 4.9V	Glass temperature : 23°C(73.4°F)
10	Engine coolant temperature	Communication fail	85°C (185°F)
11	ECV feedback	No input of ECV feedback signal	<ul><li> ECV fault signal : 1</li><li> PWM control output : maintain</li><li> Torgue : 0</li></ul>

## **REPLACEMENT**

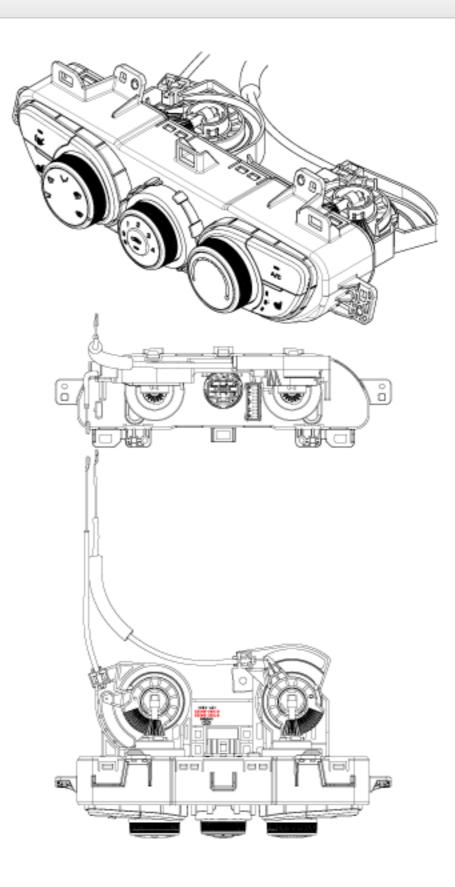
- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the heater & A/C controller (A) from the center facia loosening screws.



3. Disconnect the connectors (A) and the air hose (B).

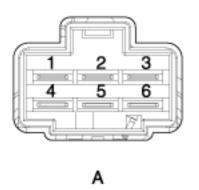


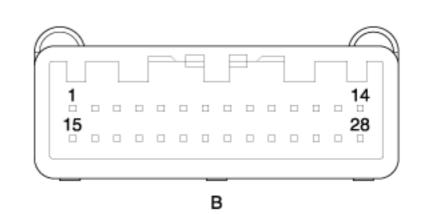




## **CONNECTOR PIN FUNCTION**

[Non-ISG type]

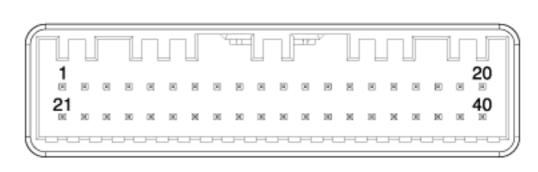




No.	Use	Pin NO.	Pin Name	No.	Use	Pin NO.	Pin Name
		1	Low			12	-
		2	Common			13	Sensor ground
Α	Blower	3	High			14	Ground
	Diowei	4	Middle low			15	ILL+(Tail)
		5	Middle high			16	Sensor ref(+5V)
		6	Ground			17	HTD
		1	Battery			18	Defog
	Main	2	IGN2	В	Main	19	Evaporator sensor(+)
		3	Detent out(+)			20	Seat heat indigator(LH) - Low
		4	Intake actuator(fresh)			21	Seat heat indigator(LH) - Mid
		5	Intake actuator(recirculation)			22	Seat heat indigator(LH) - High
В		6	Intake actuator feedback			23	Seat heat indigator(RH) - Low
		7	Max blower on signal			24	Seat heat indigator(RH) - Mid
		8	Seat heat - LH			25	Seat heat indigator(RH) - High
		9	Seat heat - RH			26	-
		10	A/C output			27	Blower on signal to common
		11	A/C select signal			28	ILL-(RHEO)

## [ISG type]





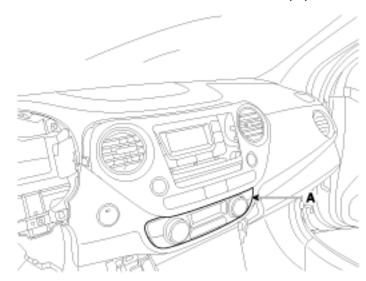
А В

No.	Use	NO.	Pin Name	No.	Use	NO.	Pin Name
		1	Low			18	-
		2	Common			19	ILL-(RHEO)
	D.	3	High			20	Ground
Α	Blower						

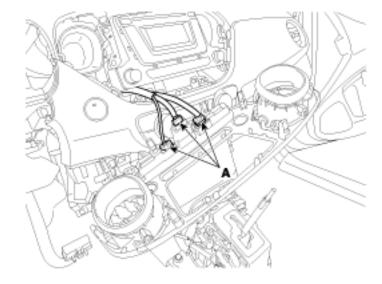
		4 Middle low	21	IGN1			
		5	Middle high			22	IGN2
		6	Ground			23	ISG DC
		1	Battery			24	Sensor ref(+5V)
		2	ILL+(Tail)			25	Evaporator sensor(+)
		3	-			26	Ambient sensor(+)
		4	HTD	В	Main	27	-
		5	Defog			28	CAN(HIGH)
		6	Detent out(+)			29	CAN(LOW)
		7	Mode actuator feedback			30	-
		8	Temperature actuator feedback			31	Seat heat indigator(LH) - Low
В	Main	9	Intake actuator feedback			32	Seat heat indigator(LH) - Mid
		10	Mode actuator (vent)			33	Seat heat indigator(LH) - High
		11	Mode actuator defog			34	Seat heat indigator(RH) - Low
		12	Temperature actuator cool			35	Seat heat indigatoR(RH) - Mid
		13	Temperature actuator warm			36	Seat heat indigator(RH) - High
		14	Intake actuator fresh			37	Max blower on signal
		15	Intake actuator recirculation			38	Blower on signal to common
		16	Seat heat - LH			39	Sensor ground
		17	Seat heat - RH			40	Ground

## **REPLACEMENT**

- 1. Disconnect the negative (-) battery terminal.
- 2. Remove the heater & A/C controller (A) from the center facia using a flat-head screwdriver or remover.



3. Disconnect the connectors (A).



## **SPECIAL SERVICE TOOLS**

Illustration	Use
	Removal and installation of disc & hub assembly.
	Illustration

## **SPECIFICATION**

## Air Conditioner

lte	m	Specification		
	Туре	5VSE9 (Externally Controlled Variable Swash Plate Type)		
Compressor	Oil type & Capacity	PAG OIL, 100±10 cc		
	Displacement	DVE9: 90 cc/rev		
Condenser	Heat Rejection	GSL: 11,900 - 3% kcal/h, DSL: 11,500 - 3% kcal/h		
Expansion valve	Туре	Block type		
Pofrigorant	Туре	R-134a, R-1234yf		
Refrigerant	Capacity	400 + 25g (14.8 ± 0.88 oz.)		

### **Blower Unit**

Item		Specification		
Intake	Control Type	Actuator		
	Туре	Sirocco		
Blower	Speed Step	FATC: Auto or 1~8 speed, MANUAL: 1~4 speed		
	Speed Control	FATC: Power mosfet, MANUAL: Blower resistor		
Air filter	Туре	Particle filter		

## Heater And Evaporator Unit

Ite	m	Specification		
	Туре	Pin & Tube type		
Heater	Heating Capacity	4,400 - 5% kcal/hr		
Пеацеі	Mode Control Type	Actuator / Cable		
	Temperature Control Type	Actuator / Cable		
	Cooling Capacity	4,300 - 5% kcal/hr		
Evaporator	Temperature Control Type	Evaporator temperature sensor		
Εναροιαιοι	A/C ON/OFF	ON: 0 ± 0.3°C (32.0 ± 0.5°F) OFF: -2.0 ± 0.3°C (28.4 ± 0.5°F)		

# Tightening Torques

Items	N.m	kgf.m	lb-ft
Compressor	19.6 ~ 33.3	2.0 ~ 3.4	14.5 ~ 24.6
Condenser - Discharge hose	5.9 ~ 9.8	0.6 ~ 1.0	4.3 ~ 7.2
Condenser - Liquid tube	5.9 ~ 9.6	0.6 ~ 1.0	
Compressor - Discharge hose			

Compressor - Suction hose	4.9 ~ 8.8	0.5 ~ 0.9	3.6 ~ 6.5
Expansion valve - Evaporator	11.8 ~ 14.7	1.2 ~ 1.5	8.7 ~ 10.9

## **TROUBLESHOOTING**

### **Problem Symptoms Table**

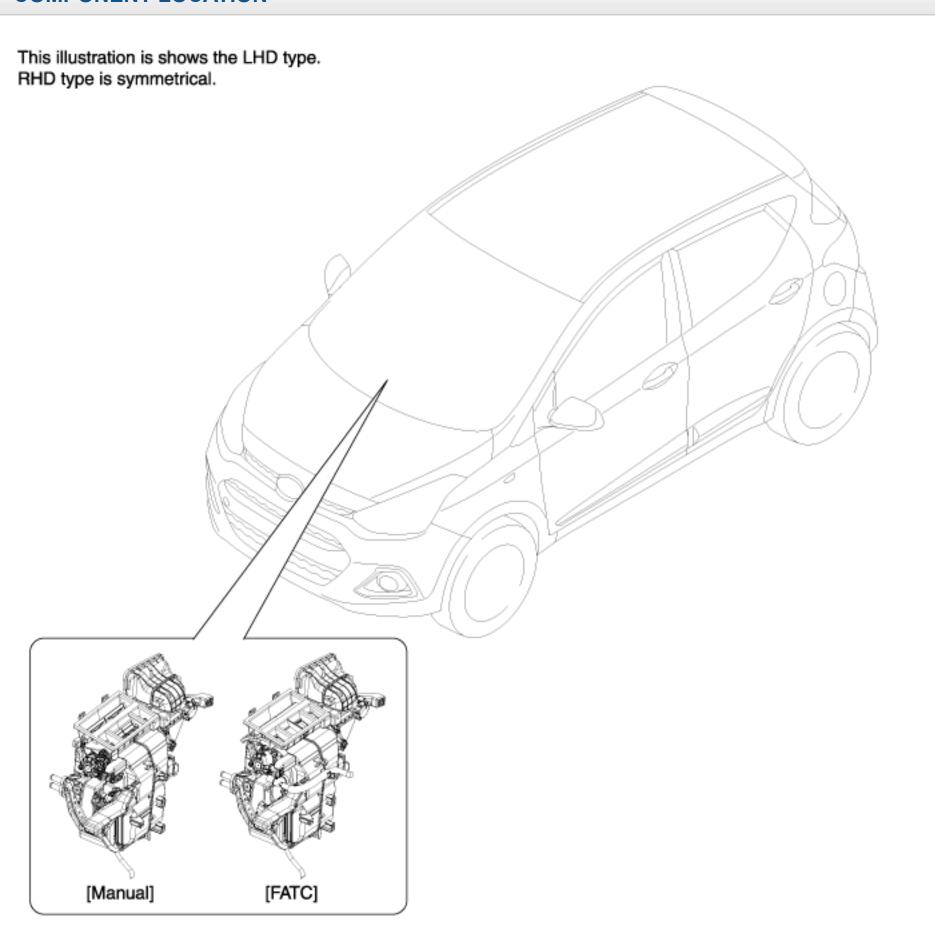
Before replacing or repairing air conditioning components, first determine if the malfunction is due to the refrigerant charge, air flow or compressor.

Use the table below to help you find the cause of the problem. The numbers indicate the priority of the likely cause of the problem. Check each part in order. If necessary, replace these parts.

After correcting the malfunction, check	k the complete system to ensure that performance is satisfactory.
Symptom	Suspect Area
	1. Blower fuse
	2. Blower relay
No blower operation	3. Blower motor
NO blower operation	4. Blower resistor, Power mosfet or PWM blower module
	5. Blower speed control switch or knob
	6. Wire harness
	1. Engine coolant capacity
No air temperature control	2. Heater control assembly
	3. Temperature control actuator or cable
	1. Refrigerant capacity
	2. A/C Fuse
	3. Compressor
	4. A/C pressure transducer
No compressor operation	5. A/C switch
	6. Evaporator temperature sensor
	7. Wire harness
	8. High CAN
	1. Refrigerant capacity
	2. Refrigerant pressure
	3. Drive belt
	4. Compressor
	5. A/C pressure transducer
No cool comes out	6. Evaporator temperature sensor
	7. A/C switch
	8. Heater control assembly
	9. Wire harness
	10. High CAN
	11. Temperature control actuator or cable
	1. Refrigerant capacity

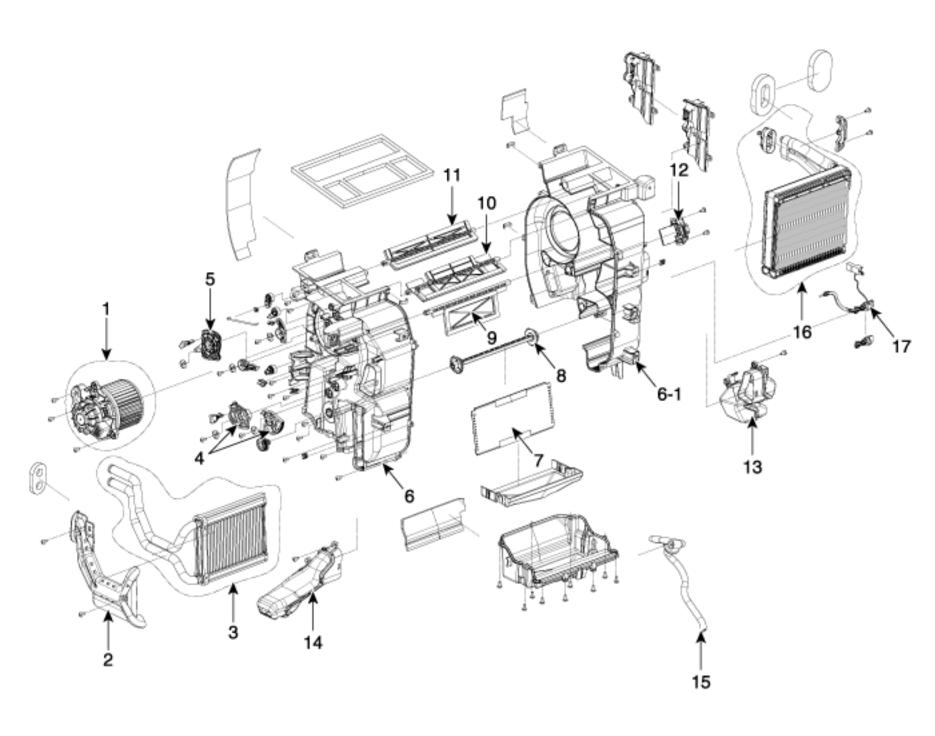
	2. Drive belt
	3. Compressor
	4. Condenser
Insufficient cooling	5. Expansion valve
	6. Evaporator
	7. Refrigerant lines
	8. A/C pressure transducer
	9. Heater control assembly
	10. High CAN
No angina idla un whan A/C switch ON	1. Engine ECM
No engine idle-up when A/C switch ON	2. Wire harness
No air inlet control	Heater control assembly
	2. Intake actuator
No mode control	Heater control assembly
No mode control	2. Mode control actuator or cable
	1. Cooling fan fuse
	2. Fan motor
No cooling fan operation	3. Blower resistor, Power mosfet or PWM blower module
	4. Engine ECM
	5. Wire harness

## **COMPONENT LOCATION**



#### **COMPONENTS**

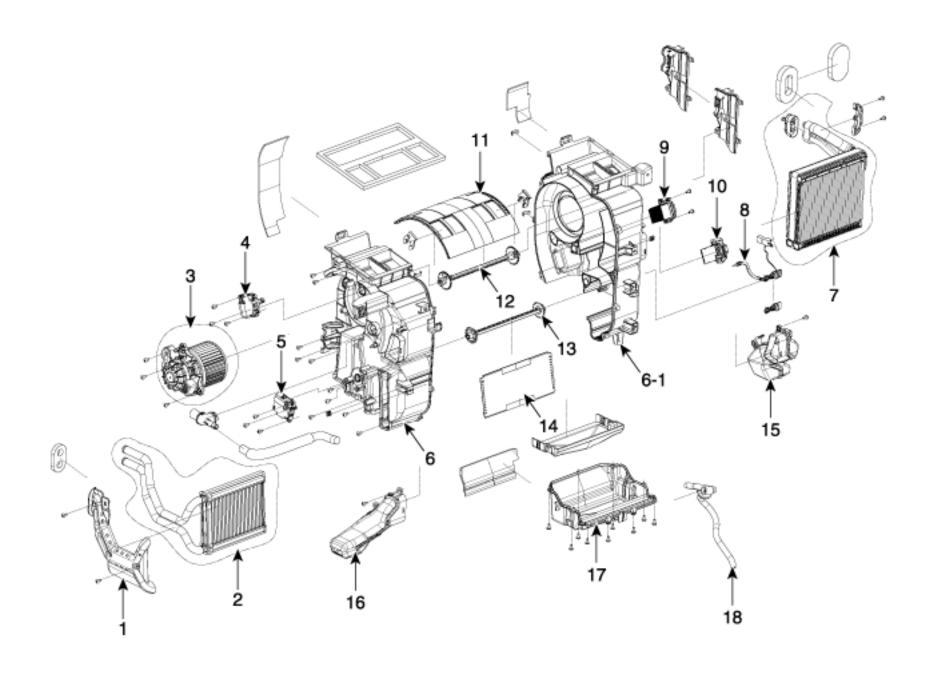
[Manual]



- 1. Motor & Wheel Assembly
- 2. Heater Pipe Cover
- 3. Heater Core Assembly
- 4. Temperature Lever
- 5. Mode Cam
- 6. Heater Case (Left)
- 6-1. Heater Case (Right)
- 7. Temperature Door Assembly
- 8. Temperature Door Shaft

- 9. Floor Door Assembly
- 10. Vent Door Assembly
- 11. DEF Door Assembly
- 12. Blower Resister Assembly
- 13. Shower Duct (Right)
- 14. Shower Duct (Left)
- 15. Drain Hose
- 16. Evaporater Core Assembly
- 17. Evaporater Temperature Sensor

#### [FATC]



- 1. Heater Pipe Cover
- 2. Heater Core Assembly
- 3. Motor & Wheel Assembly
- 4. Mode Actuator
- 5. Temperature Actuator
- 6. Heater Case (Left)
- 6-1. Heater Case (Right)
- 7. Evaporater Core Assembly
- 8. Evaporater Temperature Sensor
- 9. FET

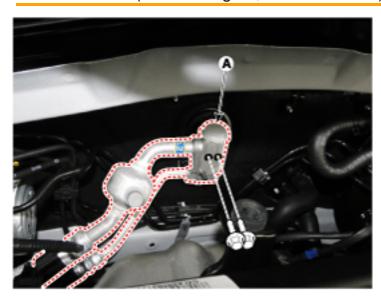
- 10. Blower Resister Assembly
- 11. Mode Door Assembly
- 12. Mode Door Shaft
- 13. Temperature Door Shaft
- 14. Temperature Door Assembly
- 15. Shower Duct (Right)
- 16. Shower Duct (Left)
- 17. Lower Heater Case
- 18. Drain Hose

#### REPLACEMENT

- 1. Disconnect the negative (-) battery terminal.
- 2. Recover the refrigerant with a recovery/recycling/charging station.
- 3. When the engine is cool, drain the engine coolant from the radiator. (Refer to Engine Mechainical System "Coolant")
- 4. Remove the expansion valve (A) from the evaporator core.

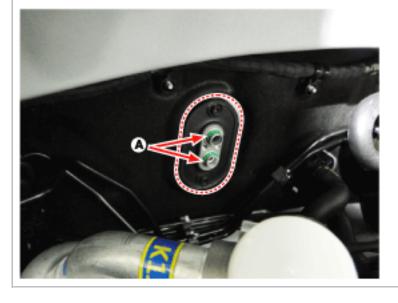
#### Tightening torque:

8.8 ~ 13.7 N.m (0.9 ~ 1.4 kgf.m, 6.5 ~ 10.1 lb-ft)



### NOTICE

- Plug or cap the lines immediately after disconnecting them to avoid moisture and dust contamination.
- When installing, replace with a new O-ring (A).



5. Disconnect the inlet (A) and outlet (B) heater hoses from the heater unit.



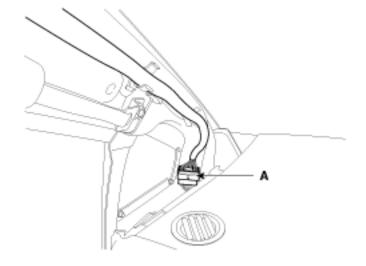
## **▲** CAUTION

Engine coolant will run out when the hoses are disconnected; drain it into a clean drip pan. Be sure not to let coolant spill on electrical parts or painted surfaces. If any coolant spills, rinse it off immediately.

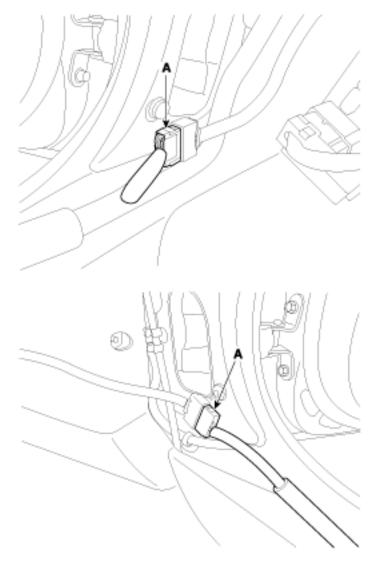
- 6. Remove the center console assembly. (Refer to Body "Center Console")
- 7. Remove the shift lever assembly.
  (Refer to Manual Transaxle System "Shift Lever")
- 8. Lower the steering column after loosening the mounting bolts and nuts. (Refer to Steering System "Steering Column and Shaft")
- Remove the cowl top cover.(Refer to Body "Cowl Top Cover")
- 10. Loosen the mounting bolts (A).



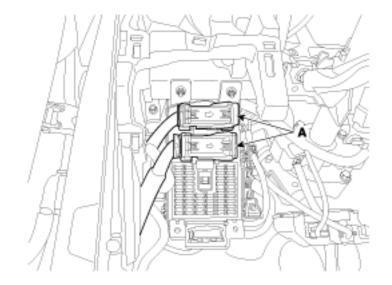
11. Remove the left front filler trim and disconnect the connector (A).



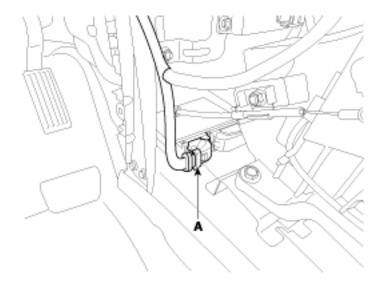
12. Remove the right and left lower cover and then disconnect connectors (A).



13. Disconnect the fuse box connectors (A).

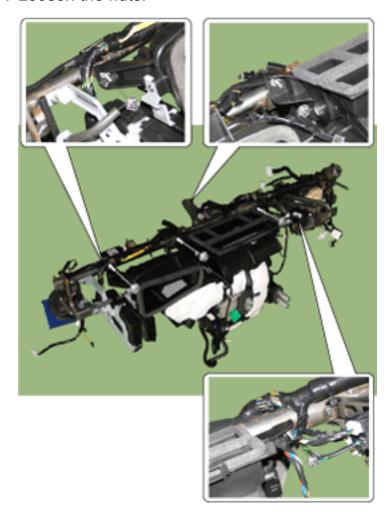


14. Disconnect the airbag connector (A).

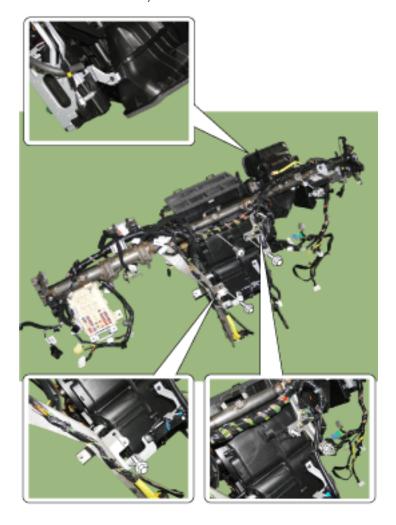


15. Remove the photo sensor. (Refer to Air Conditioning System - "Photo Sensor")

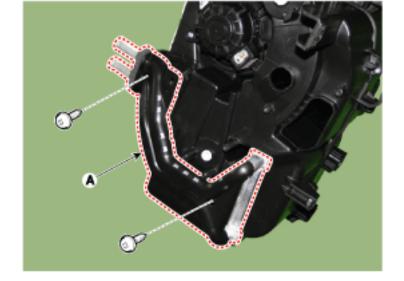
- Remove the heater & A/C control unit.
   (Refer to Controller " Heater & A/C Control Unit ")
- 17. Loosen the nuts.



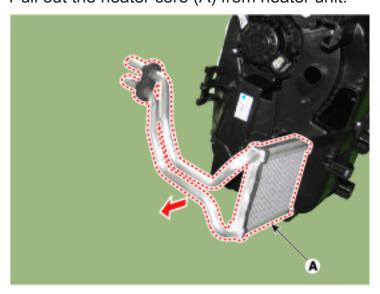
18. Loosen the bolts, a screw and a fastener.



19. Remove the heater core cover (A) after loosening the mounting screws.

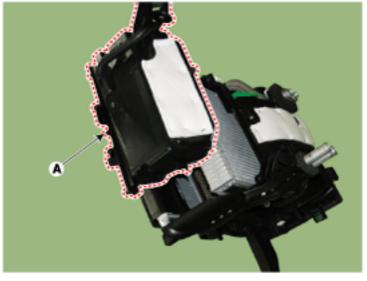


20. Pull out the heater core (A) from heater unit.



21. Remove the heater unit lower case (A) after loosening the mount screws.

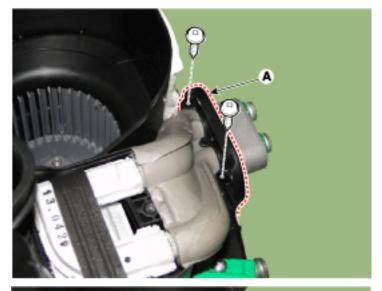


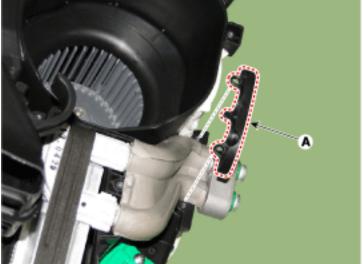


22. Loosen the bolts and remove the cover (A).

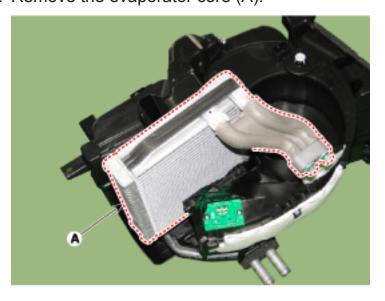


23. Loosen the bolts and remove the cover (A).





24. Remove the evaporator core (A).



### 25. Install in the reverse order of removal.

- If you're installing a new evaporator, add refrigerant oil.
- Replace the O-rings with new ones at each fitting, and apply a thin coat of refrigerant oil before installing them.

Be sure to use the right O-rings for R-134a to avoid leakage.

- Immediately after using the oil, replace the cap on the container, and seal it to avoid moisture absorption.
- Do not spill the refrigerant oil on the vehicle; it may damage the paint; if the refrigerant oil contacts the paint, wash it off immediately
- Apply sealant to the grommets.
- · Make sure that there is no air leakage.
- Charge the system and test its performance.
- Do not interchange the inlet and outlet heater hoses and install the hose clamps securely.
- Refill the cooling system with engine coolant

2016 > G 1.2 MPI > G 1.2 MPI > Heating, Ventilation and Air Conditioning > Heater > Mode Control Actuator > Description and Operation

## **DESCRIPTION**

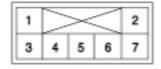
The mode control actuator is located at the heater unit.

It adjusts position of mode door by operating mode control actuator based on signal of A/C control unit. Pressing mode select switch makes the mode control actuator shift in order of Vent  $\rightarrow$  Bi-Level  $\rightarrow$  Floor  $\rightarrow$  Mix.

#### **INSPECTION**

- 1. Turn the ignition switch OFF.
- 2. Disconnect the mode control actuator connector.
- 3. Verify that the mode control actuator operates to the defog mode when connecting 12V to the terminal 4 and grounding terminal 3.

Verify that the mode control actuator operates to the vent mode when connecting in the reverse.



1. -

2. -

3. Mode Actuator (DEFOG)

4. Sensor Ground

- 5. Mode Actuator (Feedback)
- 6. Sensor REF (+5V)
- 7. Mode Actuator (Vent)
- 4. Connect the mode control actuator connector.
- 5. Turn the ignition switch ON.
- 6. Check the voltage between terminal 6 and 7.

#### **Specification**

#### [With auto defogging activated

Door position	Voltage (V)	Error detecting
Vent	$0.9 \pm 0.3$	Low voltage: 0.1V or less
Bi-Level	$0.9 \pm 0.3$	
Floor	4.1 ± 0.3	
Mix	4.1 ± 0.3	
Defog	4.1 ± 0.3	High voltage: 4.9V or more

#### [With auto defogging deactivated

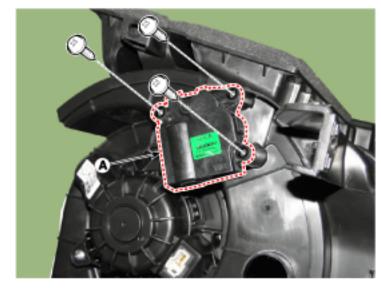
Door position	Voltage (V)	Error detecting
Vent	2.5 ± 0.3	Low voltage: 0.1V or less
Bi-Level	2.5 ± 0.3	
Floor	4.1 ± 0.3	
Mix	4.1 ± 0.3	
Defog	4.1 ± 0.3	High voltage: 4.9V or more

It will feedback current position of actuator to controls.

- 7. If the measured voltage is not specification, substitute with a known-good mode control actuator and check for proper operation.
- 8. If the problem is corrected, replace the mode control actuator.

### **REPLACEMENT**

- 1. Disconnect the negative (-) battery terminal.
- Remove the crash pad. (Refer to Body - "Crash Pad")
- Remove the BCM unit. (Refer to Body Electrical System - "BCM")
- 4. Remove the mode control actuator (A) after loosening the mounting screws.



5. Install in the reverse order of removal.

2016 > G 1.2 MPI > G 1.2 MPI > Heating, Ventilation and Air Conditioning > Heater > Temperature **Control Actuator > Description and Operation** 



## **DESCRIPTION**

The heater unit includes mode control actuator and temperature control actuator.

The temperature control actuator is located at the heater unit. It regulates the temperature by the procedure as follows. Signal from control unit adjusts position of temperature door by operating temperature switch and then temperature will be regulated by the hot/cold air ratio decided by position of temperature door.

#### **INSPECTION**

- 1. Turn the ignition switch OFF.
- 2. Disconnect the temperature control actuator connector.
- 3. Verify that the temperature control actuator operates to the warm (LHD) or cool (RHD) position when connecting 12V to the terminal 3 and grounding terminal 4.
  - Verify that the temperature control actuator operates to the cool (LHD) or warm (RHD) position when connecting in the reverse.



- 1. -
- 2. -
- 3. Temperature Actuator (Cool)
- 4. Sensor REF (+5V)

- 5. Temperature Actuator Feedback
- 6. Sensro Ground
- 7. Temperature Actuator (Warm)
- 4. Connect the temperature control actuator connector.
- 5. Turn the ignition switch ON.
- 6. Check the voltage between terminal 6 and 5 (LHD) or 7 (RHD).

#### **Specification**

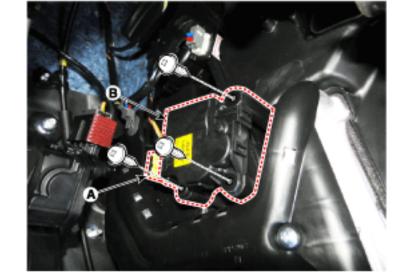
Door position	Voltage (V)	Error Detecting
Max. cooling	0.3	Low voltage: 0.1V or less
Max. heating	4.7	High voltage: 4.9V or more

It will feedback current position of actuator to controls.

- 7. If the measured voltage is not specification, substitute with a known-good temperature control actuator and check for proper operation.
- 8. If the problem is corrected, replace the temperature control actuator.

#### **REPLACEMENT**

- 1. Disconnect the negative (-) battery terminal.
- Remove the crash pad low panel. (Refer to Body - "Crash Pad")
- 3. Disconnect the connector (A) and then remove the temperature control actuator (B) after loosening the mounting screws.

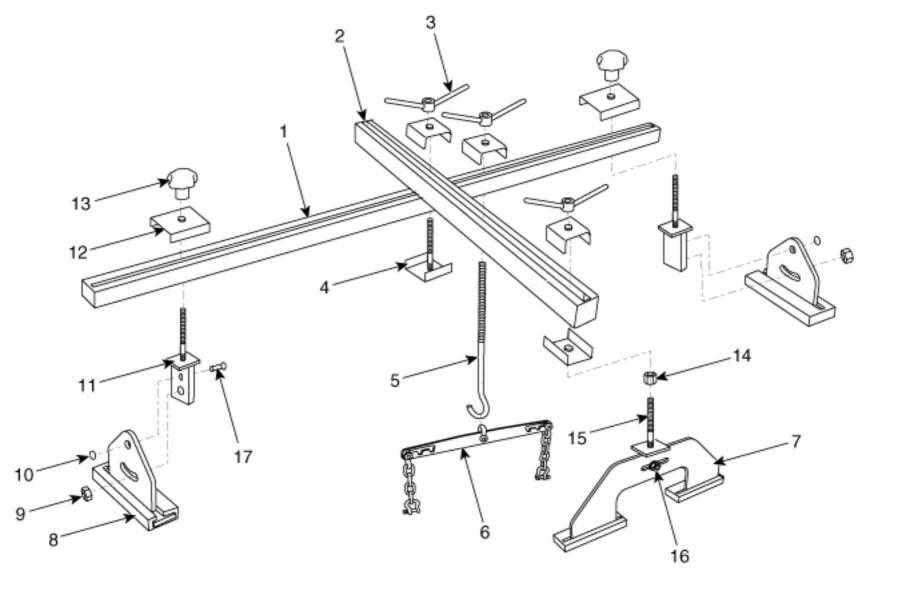


4. Install in the reverse order of removal.

# **SPECIAL SERVICE TOOLS**

Tool (Number and name)	Illustration	Use
09200-3N000 Engine support fixture (Beam)		Removal and installation of the transaxle. Use this adapter (SST No.: 09200-4X000) with the supporter (SST No.: 09200-A3100).  *Permit operating with 09200-38001.  *Refer to engine support fixture special tool assembly drawing below.
09200-2S000 Supporter		Removal and installation of the transaxle. Use this beam (SST No.: 09200-38001/3N000) with the supporter (SST No.:09200-2S000).
09200-4X000 Engine support fixture (Adapter)		Removal and installation of the transaxle. Use this beam (SST No.: 09200-3N000 or 38001) with the supporter (SST No.:09200-A3100). **Refer to engine support fixture special tool assembly drawing below.
09221-03100 Engine hanger		Ring for supporting engine.
09431-23000 Oil seal installer		Installation of transaxle case oil seal. [Using with handle (SST No.:09231-H1100)]
09231-H1100 handle		Installation of transaxle case oil seal. [Using with oil seal installer (SST No.:09431-23000)]

# \* Engine Support Fixture Special Tool Assembly Drawing



- 1. 09200-3N000 (Main bar)
- 2. 09200-3N000 (Sub bar)
- 3. 09200-3N000 (Handle)
- 4. 09200-3N000 (Stopper)
- 5. 09200-3N000 (Bolt-1)
- 6. 09200-4X000 (Adapter)
- 7. 09200-2S100 (Supporter)
- 8. 09200-2S200 (Supporter)
- 9. 09200-3N000 (Nut)

- 10. 09200-3N000 (Snap ring)
- 11. 09200-3N000 (Sub fixture)
- 12. 09200-3N000 (Stopper)
- 13. 09200-3N000 (Nut)
- 14. 09200-2S100 (Spacer)
- 15. 09200-2S100 (Sub fixture)
- 16. 09200-2S100 (Nut)
- 17. 09200-3N000 (Pin)

# **SPECIFICATIONS**

TransaxI	e type	M5EF2						
Engine	type	Kappa 1.0 MPI		Kappa 1.0 LPGi	Kappa 1.25 MPI			
Rema	ırks	5 Seater (Basic)	4 Seater (Basic)	4 Seater (Fuel pack) 13 Inch	5 Seater (Unusual appearances)	5 Seater	5 Seater (Basic)	5 Seater (Unusual appearances)
	1st	3.727	3.545	3.545	3.727	3.727	3.545	3.545
	2nd	2.056	1.895	1.895	2.056	2.056	1.895	1.895
Gear ratio	3rd	1.269	1.192	1.192	1.269	1.269	1.192	1.269
Geal Tallo	4th	0.906	0.906	0.906	0.964	0.906	0.853	0.853
	5th	0.774	0.774	0.774	0.774	0.774	0.719	0.719
	Reverse	3.636	3.636	3.636	3.636	3.636	3.636	3.636
Final gea	ar ratio	4.437	4.437	4.056	5.071	4.600	4.437	4.600

# **TIGHTENING TORQUES**

Items	N.m	kgf.m	lb-ft
Oil drain plug	58.9 ~ 78.5	6.0 ~ 8.0	43.4 ~ 57.8
Oil filler plug	58.9 ~ 78.5	6.0 ~ 8.0	43.4 ~ 57.8
Control cable bracket	14.7 ~ 21.6	1.5 ~ 2.2	10.9~15.9
Control Shaft Complete	14.7 ~ 21.6	1.5 ~ 2.2	10.9~15.9
Back up lamp switch	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Vehicle speed sensor	4.9 ~ 6.9	0.5 ~ 0.7	3.6 ~ 5.1
Shift lever assembly bolt	9.8 ~ 14.7	1.0 ~ 1.5	7.2 ~ 10.8
Transaxle support bracket mounting bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Transaxle bracket mounting bolt	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Start motor installation bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Dall rad brooket halt	107.9 ~ 127.5	11.0 ~ 13.0	79.6 ~ 94.1
Roll rod bracket bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Transaxle upper mounting bolt	58.9 ~ 78.5	6.0 ~ 8.0	43.4 ~ 57.8
Transcyle lower mounting helt	(A) 42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Transaxle lower mounting bolt	(B) 44.1 ~ 54.0	4.5 ~ 5.5	32.5 ~ 39.8

# **LUBRICANTS**

Items	Recommend lubricant	Quantity

Transaxle gear oil

API Service GL-4, SAE 70W

- SHELL: SPIRAX S6 GHME

70W

- SK : HK MTF 70W

- GS CALTEX : GS MTF HD

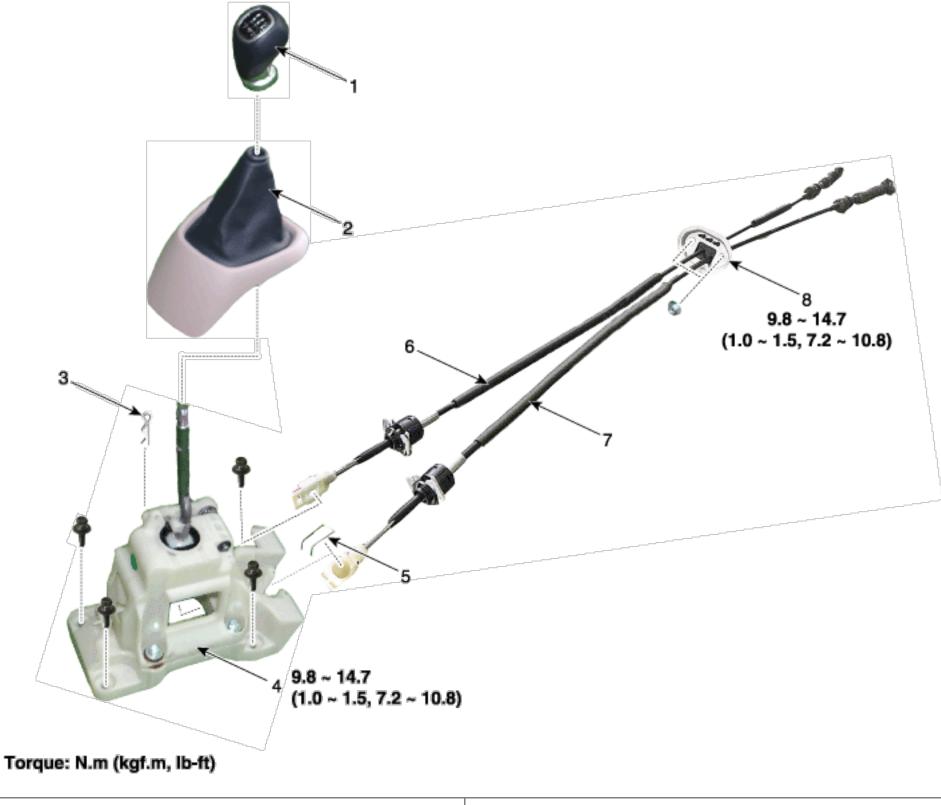
70W

1.9 ~ 2.0L (0.50 ~ 0.53 U.S.gal., 2.0 ~ 2.11U.S. qt., 1.67 ~ 1.76 lmp qt.)

### **SEALANT**

Items	Specified sealant
Control shaft complete	MS721-40 or MS721-38

### **COMPONENTS**



- 1. Knob
- 2. boots
- 3. Select cable clip
- 4. Shift lever assembly

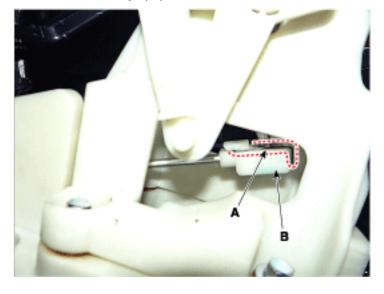
- 5. Shift cable clip
- 6. Select cable
- 7. Shift cable
- 8. Retainer

#### **REMOVAL**

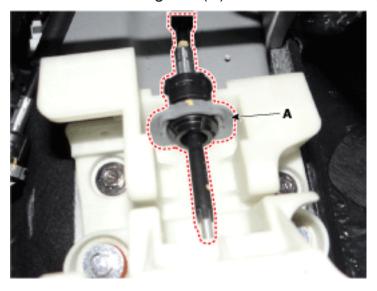
- Remove the floor console assembly. (Refer to Body - " Floor Console")
- 2. Remove the clip (A) and then remove the select cable (B) from the shift lever.



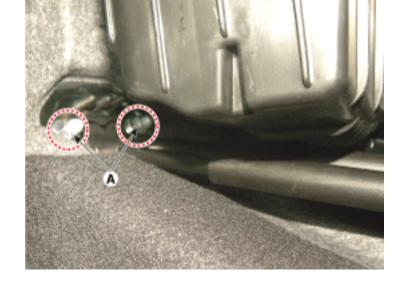
3. Remove the clip (A) and then remove the shift cable (B) from the shift lever.



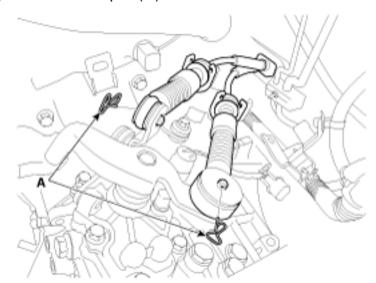
4. Remove the cable guide (A) from lever assembly.



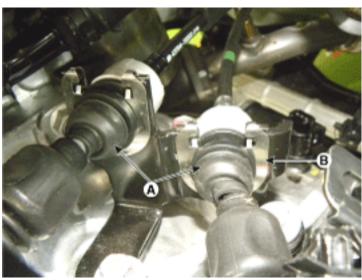
5. Remove the retainer (A) after loosen the nut.



- 6. Air cleaner assembly. (Refer to Engine Mechanical System - "Air Cleaner")
- Battery and battery tray.
   (Refer to Engine Electrical System "Battery")
- 8. Remove the control cable.
  - (1) Remove the pin (A) and washers.



(2) Make unlock clip (B) and then remove the shift & select cable (A) and clip from the bracket.



### NOTICE

- Do not reuse the clip (B).
- 9. Remove the shift cable into the cabin room side.

#### **INSTALLATION**

1. Install in the reverse order of removal.

# NOTICE

• When installing, set room side Shift lever and T/M side lever to "N" position.

# **INSPECTION**

- 1. Check operating of lever of T/M side when operating shift lever after assembly.
- 2. When shift lever to "R" position, check the position of "skirt".

# **DESCRIPTION**

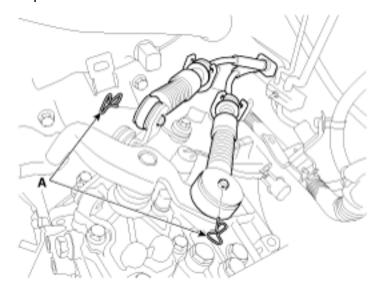
Component



- **Mounting location**: Control shaft complete is mounted on the top of the manual transaxle, and select & shift cable are equipped.
- Function : Change the gear by shifting a shift lever.

#### **REMOVAL**

- Remove the air cleaner assembly.
   (Refer to Engine Mechanical System "Air Cleaner")
- Remove the battery and battery tray. (Refer to Engine Electrical System - "Battery")
- 3. Set shift lever to N position.
- 4. Separate the control cable from the control shaft after remove the pin (A).



5. Remove the control shaft complete (A) after loosen the bolts.

#### **Tightening torque:**

14.7 ~ 21.6 Nm, 1.5 ~ 2.2 kgf.m, 10.9 ~ 15.9 lb-ft)



6. Remove the neutral return spring (A).



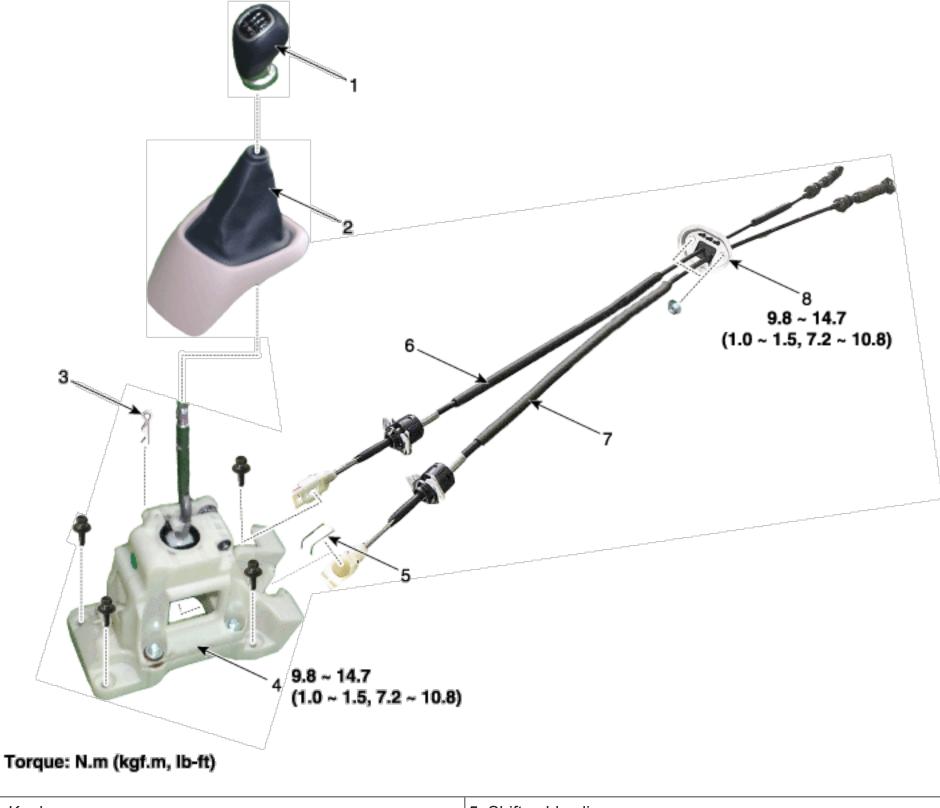
#### **INSTALLATION**

1. Install in the reverse order of removal.

# NOTICE

- When installing, set control shaft lever to neutral position.
- Install the control shaft complete after spreading sealant (MS 721-40 or MS721-38) to touching surface of control shaft complete and transaxle assembly.
- 2. After installing, check to be sure that this part operates as designed at each range of T/M side corresponding to each position of shift lever.

### **COMPONENTS**



- 1. Knob
- 2. boots
- 3. Select cable clip
- 4. Shift lever assembly

- 5. Shift cable clip
- 6. Select cable
- 7. Shift cable
- 8. Retainer

#### **REMOVAL**

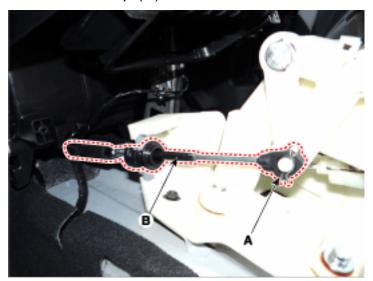
1. Remove the shift lever knob (A) by Rotating counter-clockwise.



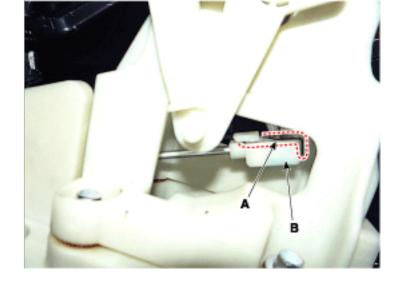
2. Remove the upper cover&boots (A).



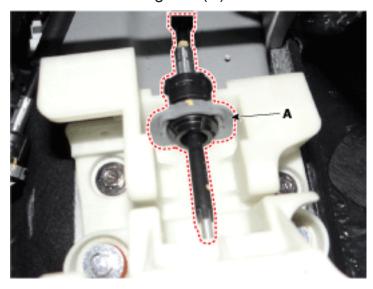
- 3. Remove the floor console assembly. (Refer to Body " Floor Console")
- 4. Remove the clip (A) and then remove the select cable (B) from the shift lever.



5. Remove the clip (A) and then remove the shift cable (B) from the shift lever.



6. Remove the cable guide (A) from lever assembly.



7. Remove the shift lever (A) after removing the mounting bolts.

### Tightening torque:

9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)



### **INSTALLATION**

1. Install in the reverse order of removal.

### NOTICE

• When installing, set room side Shift lever and T/M side lever to "N" position.

### **INSPECTION**

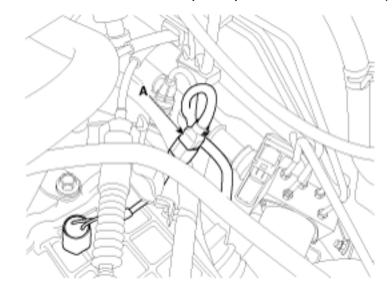
1.	. Check operating of lever of T/M side when operating shift lever after assembly.			
2.	2. When shift lever to "R" position, check the position of "skirt".			

## **DESCRIPTION**

- Components location : Manual transaxle case
- Operation principle: Back up lamp switch is pushed by the reverse lug sliding when select arm, and switches the back up lamp.
- Function: Turn on the back up lamp when reversing.

#### **INSPECTION**

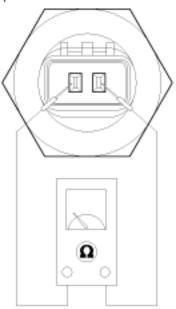
- Remove the air cleaner assembly.
   (Refer to Engine Mechanical System "Air Cleaner")
- Remove the battery and battery tray.(Refer to Engine Electrical System "Battery")
- 3. Disconnect the back up lamp switch connector (A).



4. Check the continuity between no. 1 and 2 terminals of backup lamp switch. When the shift lever is in reverse, there should be continuity.

Condition	1	2
Reverse Range	•	•
Other Range		

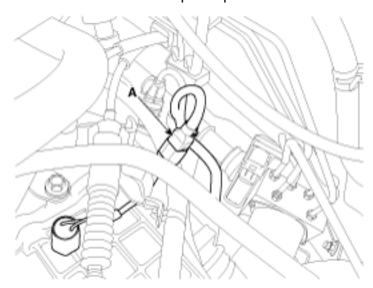
"The back up Lamp "ON" shall keep over 0.5mm(0.02in) From ON-OFF poinrt.



#### **REPLACEMENT**

- Remove the air cleaner assembly.
   (Refer to Engine Mechanical System "Air Cleaner")
- Remove the battery and battery tray. (Refer to Engine Electrical System - "Battery")

3. Disconnect the back up lamp switch connector (A).



4. Remove the back up lamp switch (A) and then replace the switch.

## Tightening torque:

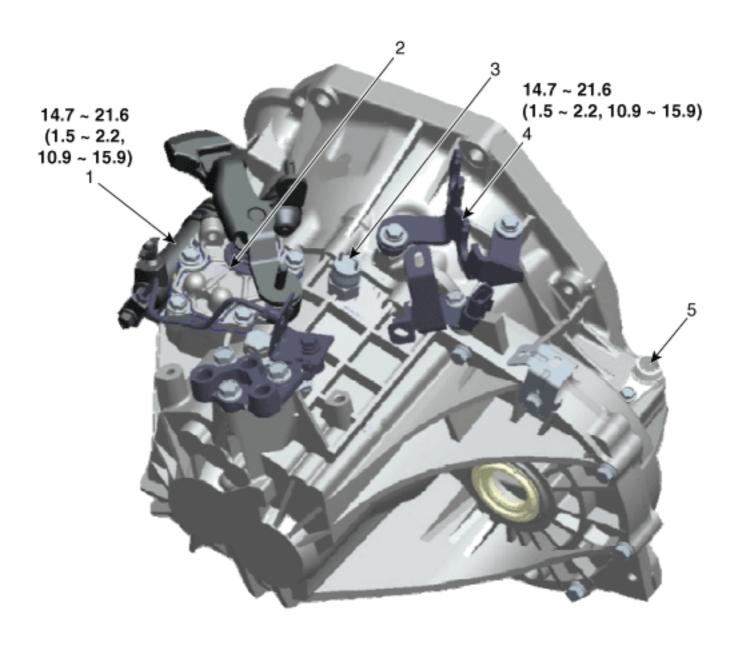
29.4 ~ 34.3 N.m (3.0 ~ 3.5 kgf.m, 21.7 ~ 25.3 lb-ft)



# **SPECIFICATION**

ltem	Specification	
Current voltage	13V	
Working voltage	DC 10~15V	
Operating force	3.0kg Max	
Voltage drop	-0.4V	
Working temperature	-30°C ~ 100°C [-30°F ~ 212°F]	

## **COMPONENTS**



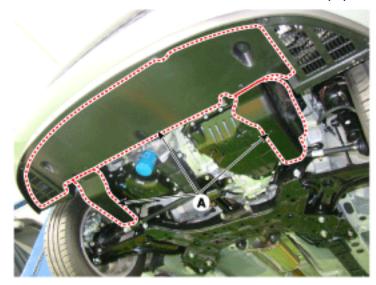
Torque: N.m (kgf.m, lb-ft)

- 1. Clutch release cylinder
- 2. Control shaft complete
- 3. Back-up lamp switch

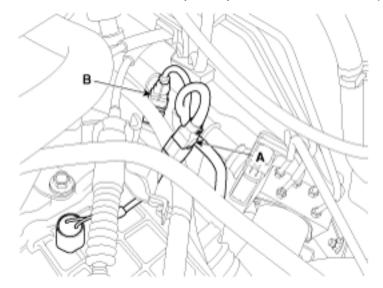
- 4. Shift cable bracket
- 5. Speed sensor

## **REMOVAL**

- Remove the air cleaner assembly.
   (Refer to Engine Mechanical System "Air Cleaner")
- Remove the battery and battery tray. (Refer to Engine Electrical System - "Battery")
- 3. Drin the transaxle fluid.
- 4. Remove the under cover and side cover (A).



5. Disconnect the back up lamp switch connector (A) and the vehicle speed sensor connector (B).

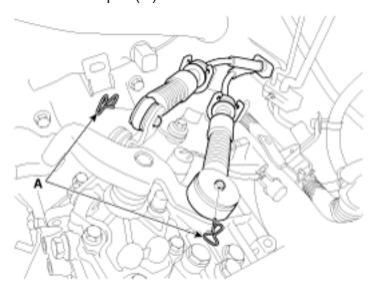


6. Remove the ground wire by removing a bolt.



7. Remove the control cable.

(1) Remove the pin (A) and washers.



(2) Loosen the control cable bracket bolts.

## **Tightening torque:**

14.7 ~ 21.6 Nm, 1.5 ~ 2.2 kgf,m, 10.9 ~ 15.9 lb-ft)



8. Remove the bracket (A).

### Tightening torque:

 $2.9 \sim 4.9 \text{ N.m} (0.3 \sim 0.5 \text{ kgf.m}, 2.2 \sim 3.6 \text{ lb-ft})$ 

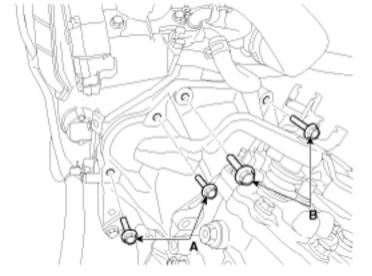


9. Remove the starter motor mounting bolts (A-2ea) and the transaxle upper mounting bolts (B-2ea).

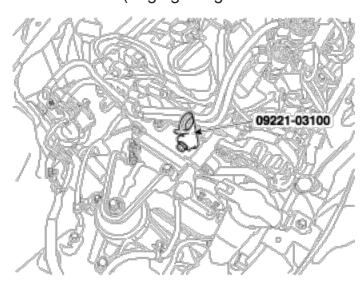
#### **Tightening torque:**

(A) 42.2 ~ 53.9 N.m (4.3 ~ 5.5 kgf.m, 31.1 ~ 39.8 lb-ft)

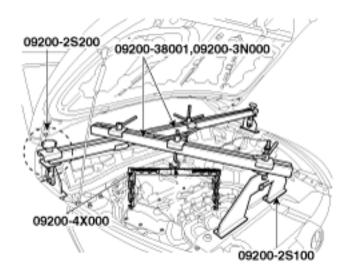
(B) 58.9 ~ 78.5 N.m (6.0 ~ 8.0 kgf.m, 43.4 ~ 57.8 lb-ft)



10. Install the SST (enging hanger SST No.: 09221-03100) on engine room.



- 11. Remove the cowl top cover.
  (Refer to Body "Cowl Top Cover")
- Assemble the engine support fixture.
   (Refer to Special Service Tools " Engine support fixture special tool assembly drawing")
- 13. Using the engine support fixture (beam No.: 09200-38001 or 09200-3N000, supporter No.: 09200-2S100, 09200-2S200, adapter No.: 09200-4X000), hold the engine and transaxle assembly safely.



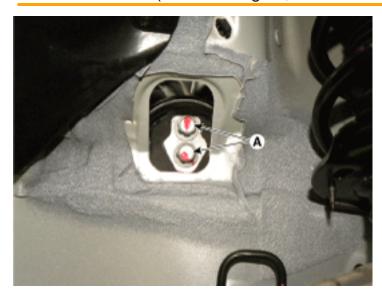
- 14. Remove the manual transaxle support bracket.
  - (1) Remove the cover (A).



(2) Remove the manual transaxle mounting bracket bolts (A).

### **Tightening torque:**

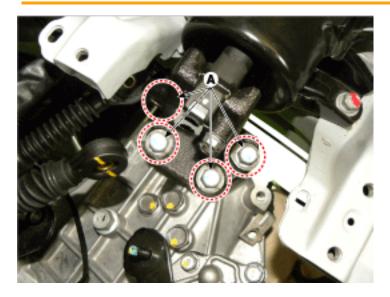
88.3 ~ 107.9 N.m (9.0 ~ 11.0 kgf.m, 65.1 ~ 79.6 lb-ft)



(3) Loosen the manual transaxle support bracket bolts (A).

### **Tightening torque:**

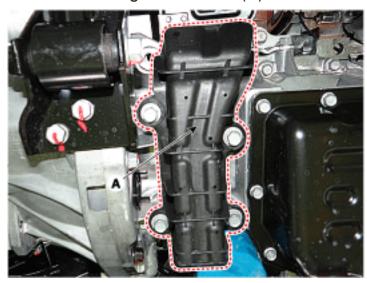
42.2 ~ 53.9 N.m (4.3 ~ 5.5 kgf.m, 31.1 ~ 39.8 lb-ft)



- Remove the under cover.
   (Refer to Engine Mechanical System "Engine Room Under Cover")
- 16. Remove the heater protector (A).



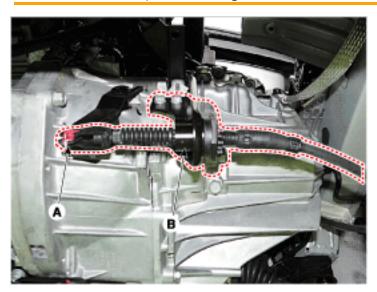
- 17. Remove the front drive shaft assembly.(Refer to Driveshaft and axle "Front Driveshaft")
- 18. Remove the air guard bracket (A).



- 19. Remove the clip (A).
- 20. Remove the clutch cable (B) from the transaxle by removing the bolts.

### **Tightening torque:**

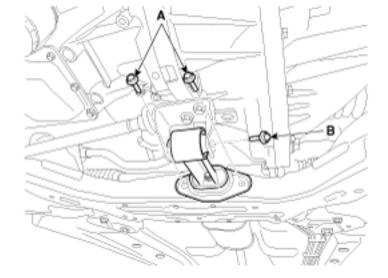
14.7 ~ 21.6 N.m (1.5 ~ 2.2 kgf.m, 10.8 ~ 15.9 lb-ft)



21. Remove the roll stopper bracket by removing the bolts (A-1ea, B-2ea).

### **Tightening torque:**

- (A) 49.0 ~ 63.7 N.m (5.0 ~ 6.5 kgf.m, 36.2 ~ 47.0 lb-ft)
- (B) 107.9 ~ 127.5 N.m (11.0 ~ 13.0 kgf.m, 79.6 ~ 94.1 lb-ft)



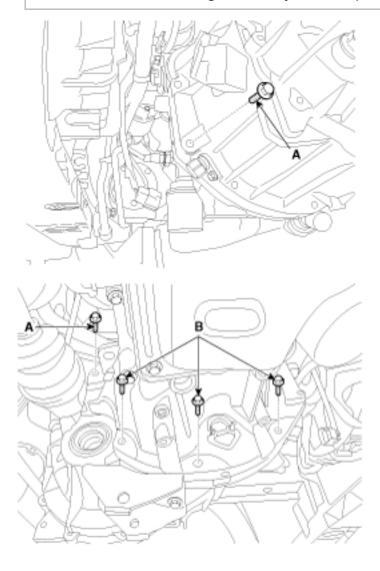
22. Remove the manual transaxle with a jack after removing the mounting bolts (A-2ea, B-3ea).

### **Tightening torque:**

- (A) 42.2 ~ 53.9 N.m (4.3 ~ 5.5 kgf.m, 31.1 ~ 39.8 lb-ft)
- (B) 44.1 ~ 54.0 N.m (4.5 ~5.5 kgf.m, 32.5 ~ 39.8 lb-ft)

### **NOTICE**

Be careful not to damage other system or parts near when removing the transaxle assembly.



## **INSTALLATION**

## i Information

If the oil seal on the transaxle case side is damaged and fluid is leaking, replace the oil seal with a new unit. When installing the new oil seal, use the specialized tool.

Oil seal installer: 09431-23000

Handle: 09231-H1100



- 1. Install in the reverse order of removal.
- 2. Add to manual transaxle fluid after Installing the manual transaxle. (Refer to Manual Transaxle System "Manual Transaxle Fluid")

## **GENERAL INFORMATION**

### 1. Check & Change intervals

Check & Replenishment	Change		Canacity	Oil appoification
	Normal Use	Severe Use	Capacity	Oil specification
60000 km / 4 years (40000 miles / 4years)  No service required (80000 miles)		API Service GL-4, SAE 70W		
	No service		1.9 ~ 2.0L (0.50 ~ 0.53 U.S.gal., 2.0 ~ 2.11U.S. qt., 1.67 ~ 1.76 lmp qt.)	- SHELL : SPIRAX S6 GHME 70W
	required			- SK : HK MTF 70W
				- GS CALTEX : GS MTF HD 70W

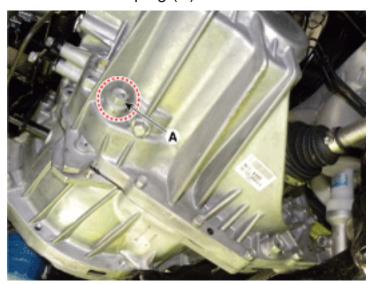
## 1 Information

Severe usage is defined as

- Driving in dusty, rough roads
- Driving in areas using salt or other corrosive materials or in very cold weather
- Driving in sandy areas
- Driving in mountainous areas
- Towing a trailer
- · Driving for patrol car, taxi, commercial car or vehicle towing
- Driving over 170 Km

## **INSPECTION**

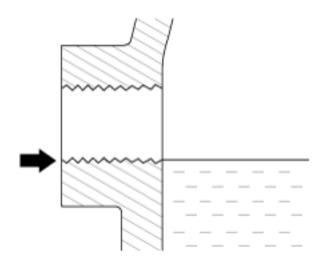
- 1. Uplift the vehicle with lift.
- 2. Loosen the filler plug (A).



3. Check the oil level.



Oil level must be up to fill the hole, if not, add oil until it runs over.



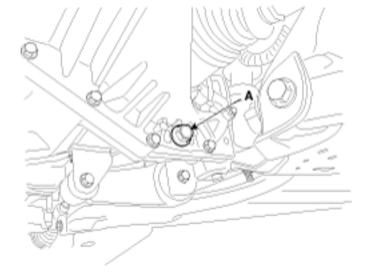
4. Install the filler plug.

### **Tightening torque:**

58.9 ~ 78.5 N.m (6.0 ~ 8.0 kgf.m, 43.4 ~ 57.8 lb-ft)

### **REPLACEMENT**

- 1. Uplift the vehicle with lift.
- 2. Drain the manual transaxle oil after loosening the drain plug (A).



- 3. Install the drain plug with new gasket.
- 4. Loosen the oil level filler plug (A).



5. Add new oil through the filler plug hole.

Standard oil: API Service GL-4, SAE 70W (SHELL: SPIRAX S6 GHME 70W, SK: HK MTF 70W, GS

CALTEX: GS MTF HD 70W)

**Oil capacity:**  $1.9 \sim 2.0 \text{ L}$  ( $0.50 \sim 0.53 \text{ U.S.gal.}$ ,  $2.01 \sim 2.11 \text{ U.S. qt.}$ ,  $1.67 \sim 1.76 \text{ lmp qt.}$ )

6. Install the filler plug.

### **Tightening torque:**

58.9 ~ 78.5 N.m (6.0 ~ 8.0 kgf.m, 43.4 ~ 57.8 lb-ft)

## **DESCRIPTION**

Component location: Manual transaxle case

Operation principle: Vehicle Speed Sensor (VSS) is hall sensor type and senses the rotating speed of differential gear.

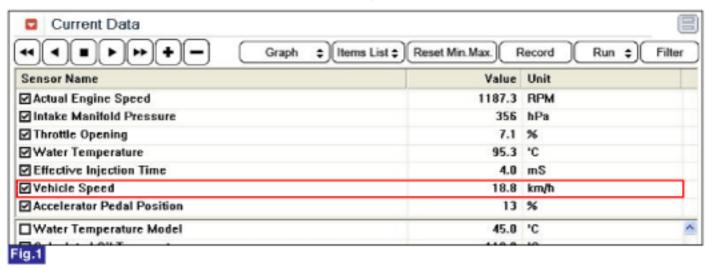
#### **Function**

- Comparing engine speed with vehicle speed calculated based on vehicle speed sensor signal, ECM recognizes engaged gear.
- Based on the information about engaged gear, ECM performs optimum fuel injection quantity correction.
- VSS signal is also used in speed meter of cluster, BCM, etc.

#### **INSPECTION**

### W/Harness Inspection

- 1. Check the vehicle speed sensor by using the scan tool. (if normal, current vehicle speed is display)
- 2. Check if current vehicle speed is same as vehicle speed displayed on the GDS.



- 3. Check the damage to the connectors and wiring.
- 4. Check the power.
  - (1) Turn ignition switch OFF.
  - (2) Disconnect the vehicle speed sensor.
  - (3) Turn ignition switch ON.
  - (4) Check the voltage of the power terminal.

Specification: 11.5V ~ 13.0V

- 5. Check the signal.
  - (1) Turn ignition switch OFF.
  - (2) Disconnect the vehicle speed sensor.
  - (3) Turn ignition switch ON.
  - (4) Check the voltage of the signal terminal.

Specification: 8.0V ~ 11.5V

- 6. Check the ground.
  - (1) Turn ignition switch OFF.
  - (2) Disconnect the vehicle speed sensor.
  - (3) Turn ignition switch ON.
  - (4) Check the voltage between signal terminal and body ground.
  - (5) Check the voltage between signal terminal and ground terminal.

Specification: 4) - 5) = Within 200mV

- 1. IG KEY "OFF", ENGINE "OFF".
- 2. Disconnect the vehicle speed sensor (VSS) connector.
- 3. Disconnect the VSS and Driven gear assy'.
- 4. Check rotating state of VSS driven gear.
- 5. Connect VSS connector and IG KEY "ON".
- 6. Rotate Driven gear with hand.

**Specification :** Vehicle Speed Signal generates.

### **REMOVAL**

- Remove the air cleaner assembly.
   (Refer to Engine Mechanical System "Air Cleaner")
- Remove the battery and battery tray.
   (Refer to Engine Electrical System "Battery")
- 3. Disconnect the vehicle speed sensor connector.



4. Remove the vehicle speed sensor after removing the bolt (A).

#### **Tightening torque:**

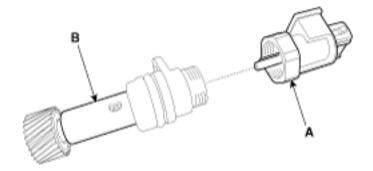
 $4.9 \sim 6.9 \text{ N.m} (0.5 \sim 0.7 \text{ kgf.m}, 3.6 \sim 5.1 \text{ lb-ft})$ 



### **NOTICE**

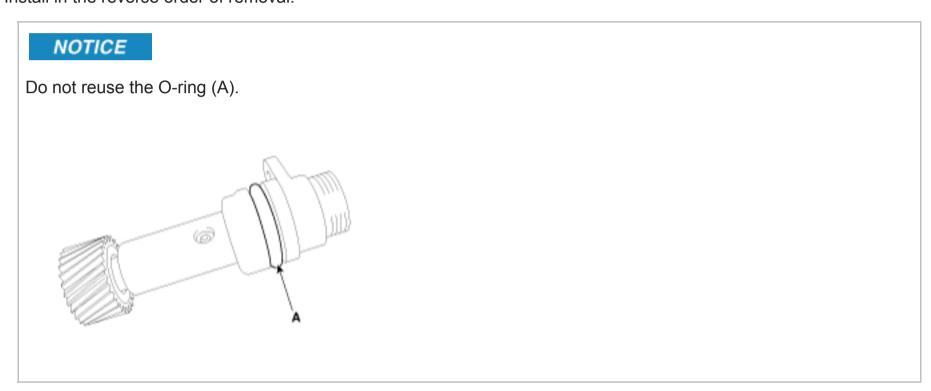
After removing, be careful not to enter dust, foreign matters, etc in speed sensor hole.

5. Separate the vehicle speed sensor (A) and driven gear (B).



## **INSTALLATION**

1. Install in the reverse order of removal.

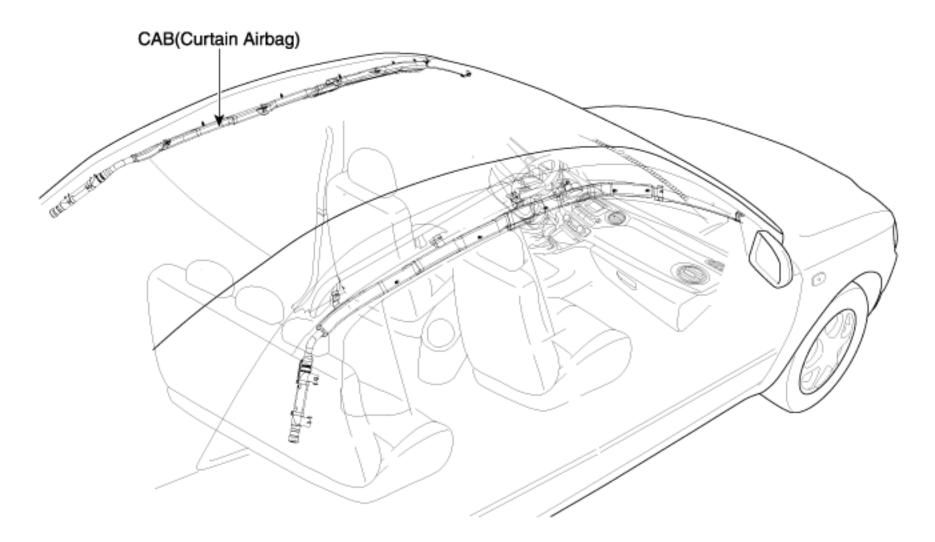


2016 > G 1.2 MPI > G 1.2 MPI > Manual Transaxle System > Manual Transaxle System > Vehicle Speed Sensor > Specifications

# **SPECIFICATION**

ltem	Specification	
Туре	Hall sensor	
Working voltage	6.5 ~1 5V	
Output voltage	VL ≤ 0.5 V (When output current is 15mA flows)	

## **COMPONENTS**



2016 > Engine > G 1.2 MPI > Restraint > Airbag Module > Curtain Airbag (CAB) Module > Description and Operation

## **DESCRIPTION**

Curtain airbags are installed inside the headliner (LH and RH) and protect the driver and passanger from danger when side crash occurs. The SRSCM determines deployment of curtain airbag by using side impact sensor (SIS) signal.



Never attempt to measure the circuit resistance of the airbag module even if you are using the specified tester. If the circuit resistance is measured with a tester, accidental airbag deployment will result in serious personal injury.

## **REMOVAL**

1. Disconnect the battery negative(-) cable.

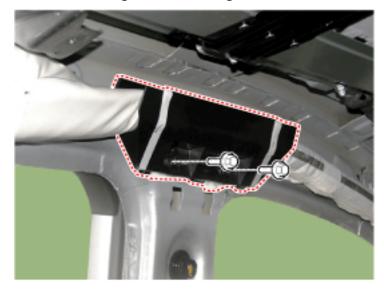


Wait for 3minutes before beginning work.

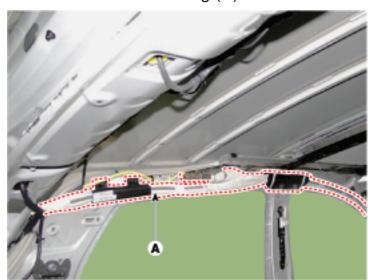
- 2. Remove Side Trim and Roof Trim.(Refer to Body "Roof Trim".)
- 3. Disconnect the Curtain Airbag harness connector (A).



4. After loosening the mounting bolts, remove the CAB bracket (A).



5. Remove the curtain airbag (A).



### **INSTALLATION**

## **▲** CAUTION

- · Be sure to install the harness wires not to be pinched or interfered with other parts.
- 1. Remove ignition key from the vehicle.
- 2. Disconnect the negative (-) cable from battery and wait for at least three minutes.
- 3. Install a Curtain Airbag (CAB) on the mounting bracket.
- 4. Tighten the CAB mounting bolts.

#### **Tightening torque**

:  $1.1 \sim 1.3 \text{ kgf.m}(10.8 \sim 12.7 \text{ Nm}, 7.9 \sim 9.4 \text{ lb.ft})$ 

## **▲** CAUTION

- Never twist the airbag module when installing it. If the module is twisted, airbag module may operate abnormally.
- 5. Connect the CAB connector.
- 6. Install Side Trim and Roof Trim.(Refer to Body "Roof Trim".)
  - Side trim, Roof trim
- 7. Reconnect the battery negative cable.
- 8. After installing the Curtain Airbag (CAB), confirm proper system operation:

### NOTICE

Turn the ignition switch ON; the SRS indicator light should be turned on for about six seconds and then go off.

#### **AIRBAG DISPOSAL**

## Special Tool Required

Deployment tool 0957A-34100A

Before scrapping any airbags or side airbags (including those in a whole vehicle to be scrapped), the airbags or side airbags must be deployed. If the vehicle is still within the warranty period, before deploying the airbags or side airbags, the Technical Manager must give approval and/or special instruction. Only after the airbags or side airbags have been deployed (as the result of vehicle collision, for example), can they be scrapped.

If the airbags or side airbags appear intact (not deployed), treat them with extreme caution. Follow this procedure.

### Deploying airbags in the vehicle

If an SRS equipped vehicle is to be entirely scrapped, its airbags or side airbags should be deployed while still in the vehicle. The airbags or side airbags should not be considered as salvageable parts and should never be installed in another vehicle.

- 1. Turn the ignition switch OFF, and disconnect the battery negative cable and wait at least three minutes.
- 2. Confirm that each airbag or side airbag is securely mounted.
- 3. Confirm that the special tool is functioning properly by following the check procedure.
  - (1) Driver's Airbag:
    - A. Remove the driver's airbag and install the SST(0957A-38500).
    - B. Install the driver's airbag on the steering wheel.
  - (2) Front Passenger's Airbag:
    - A. Remove the glove box, then disconnect the 2P connector between the front passenger's airbag and SRS main harness.
    - B. Install the SST(0957A-38500).
  - (3) Side Airbag:
    - A. Disconnect the 2P connector between the side airbag and side wire harness.
    - B. Install the SST (0957A-3F100).
  - (4) Curtain Airbag:
    - A. Disconnect the 2P connector between the curtain airbag and wire harness.
    - B. Install the SST(0957A-38500).
  - (5) Seat Belt Pretensioner:
    - A. Disconnect the 2P connector from the seat belt pretensioner.
    - B. Install the SST(0957A-38500).
- 4. Place the deployment tool at least thirty feet (10 meters) away from the airbag.
- 5. Connect a 12 volt battery to the tool.
- 6. Push the tool's deployment switch. The airbag should deploy (deployment is both highly audible and visible: a loud noise and rapid inflation of the bag, followed by slow deflection)
- 7. Dispose of the complete airbag. No part of it can be reused. Place it in a sturdy plastic bag and seal it securely.



## Deploying the airbag out of the vehicle

If an intact airbag has been removed from a scrapped vehicle, or has been found defective or damage during transit, storage or service, it should be deployed as follows:

- 1. Confirm that the special is functioning properly by following the check procedure on this page.
- 2. Position the airbag face up, outdoors on flat ground at least thirty feet (10meters) from any obstacles or people.

## Disposal of damaged airbag

- 1. If installed in a vehicle, follow the removal procedure of driver's airbag front passenger's and side airbag.
- 2. In all cases, make a short circuit by twisting together the two airbag inflator wires.
- 3. Package the airbag in exactly the same packing that the new replacement part come in.

## **COMPONENTS**



- 1. Dirver Airbag (DAB)
- 2. Clock Spring

3. Steering Wheel

2016 > Engine > G 1.2 MPI > Restraint > Airbag Module > Driver Airbag (DAB) Module and Clock Spring > Description and Operation

## **DESCRIPTION**

Driver Airbag (DAB) is installed in steering wheel and electrically connected to SRSCM via clockspring. It protects the driver from danger by deploying a bag when frontal crash occurs. The SRSCM determines deployment of Driver Airbag (DAB).



Never attempt to measure the circuit resistance of the airbag module (squib) even if you are using the specified tester. If the circuit resistance is measured with a tester, accidental airbag deployment will result in serious personal injury.

### **REMOVAL**



Wait for 3minutes before beginning work.

- 1. Disconnect the battery negative cable and wait at least three minutes before beginning work.
- 2. Remove the two airbag module mounting bolts (2EA).





3. Disconnet the horn connector(A).

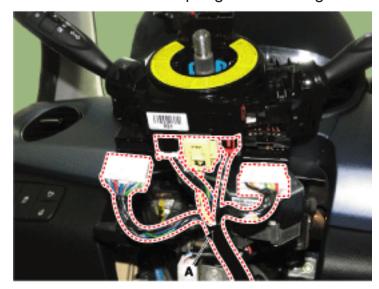
# **▲** WARNING

The removed airbag module should be stored in a clean, dry place with the pad cover face up.

4. Seperate the airbag module from the steering wheel after disconnecting the connector (C), with removing airbag module connector locking pin after removing the wiring fixing clip (B).



- 5. Remove the steering wheel and steering wheel column cover. (Refer to Steering System "Steefing Column and Shaft".)
- 6. Disconnect the clock spring and steering remote controller switch connectors (A), then remove the clock spring.



### **INSPECTION**

## Driver Airbag (DAB)

If any improper parts are found during the following inspection, replace the airbag module with a new one.

## **▲** CAUTION

Never attempt to measure the circuit resistance of the airbag module (squib) even if you are using the specified tester. If the circuit resistance is measured with a tester, accidental airbag deployment will result in serious personal injury.

- 1. Check pad cover for dents, cracks or deformities.
- 2. Check the airbag module for denting, cracking or deformation.
- 3. Check hooks and connectors for damage, terminals for deformities, and harness for binds.
- 4. Check airbag inflator case for dents, cracks or deformities.



5. Install the airbag module to the steering wheel to check for fit or alignment with the wheel.

## Clockspring

- 1. If, as a result of the following checks, even one abnormal point is discovered, replace the clock spring with a new one.
- 2. Check connectors and protective tube for damage, and terminals for deformities.



## **INSTALLATION**



Center the front wheels and remove the ignition key. Failure to do so may damage SRS system inoperative, risking

serious driver injury.

- 1. Remove ignition key from the vehicle.
- 2. Disconnect the negative (-) cable.



Wait for 3minutes before beginning work.

- 3. Connect the clock spring harness connetor and steering remocon switch harness connector to the clock spring.
- Set the center position by getting marks between the clock spring and the cover into line. Make an array the mark (►
   d) by turning the clock spring clockwise to the stop and then 3 revolutions counterclockwise.



- 5. Install the steering wheel column cover and the steering wheel. (Refer to Steering System "Steering Column and Shaft".)
- 6. Connect the Driver Airbag (DAB) module connector and horn connector, then install the Driver Airbag (DAB) module on the steering wheel.
- 7. Secure the Driver Airbag (DAB) with the new mounting bolts.

#### **Tightening torque**

: 0.8 ~ 1.1 kgf.m (7.9 ~ 10.8 Nm, 5.8 ~ 8.0 lb-ft)

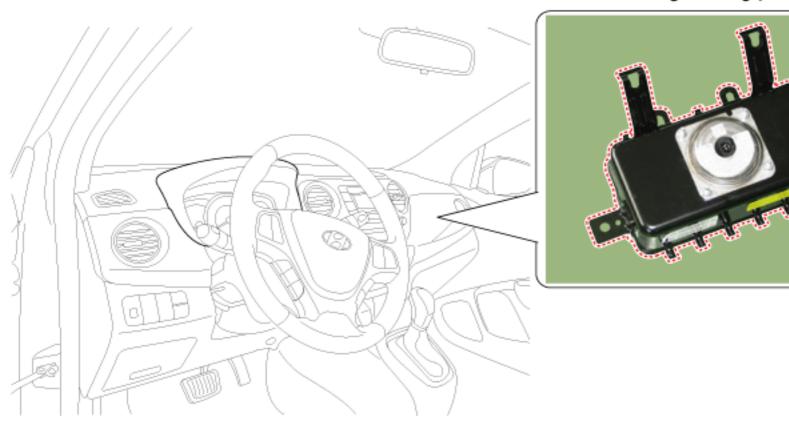
- 8. Connect the battery negative cable.
- 9. After installing the airbag, confirm proper system operation:

### NOTICE

Turn the ignition switch ON; the SRS indicator light should be turned on for about six seconds and then go off. Make sure horn button works.

## **COMPONENTS**





2016 > Engine > G 1.2 MPI > Restraint > Airbag Module > Passenger Airbag (PAB) Module > Description and Operation

## **DESCRIPTION**

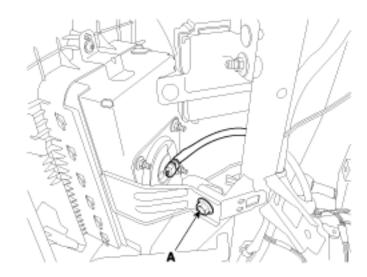
The passenger Airbag (PAB) is installed inside the crash pad and protects the front passenger in the event of a frontal crash. The SRSCM determines if and when to deploy the PAB.



Never attempt to measure the circuit resistance of the airbag module (squib) even if you are using the specified tester. If the circuit resistance is measured with a tester, accidental airbag deployment will result in serious personal injury.

### **REMOVAL**

- 1. Disconnect the battery negative cable and wait for at least three minutes before beginning work.
- 2. Remove the glove box. (Refer to Body "Glove Box Housing".)
- 3. Disconnect the PAB connector and remove the PAB fastener nuts (A).



4. Remove the crash pad. (Refer to Body - "Glove Box Housing".)

### NOTICE

Replace the crash pad which is damaged while PAB is deployed.

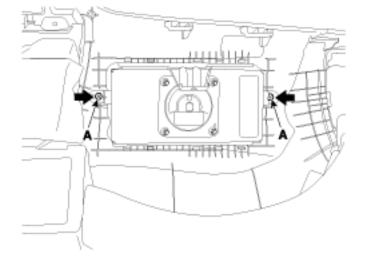
5. Remove the mounting screws from the crash pad. Then remove the passenger airbag.

## **▲** CAUTION

The removed airbag module should be stored in a clean, dry place with the pad cover face up.

### **INSTALLATION**

- 1. Remove ignition key from the vehicle.
- 2. Disconnect the negative (-) cable from battery and wait for at least three minutes.
- 3. Place a Passenger Airbag (PAB) on the crash pad and tighten the Passenger Airbag (PAB) mounting screws (A).



- 4. Install the crash pad. (Refer to Body "Glove Box Housing".)
- 5. Tighten the PAB mounting screws.

### **Tightening torque**

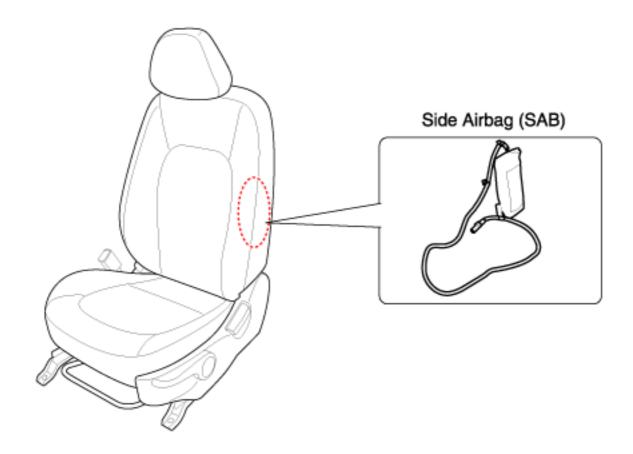
:  $0.8 \sim 0.9 \text{ kgf.m}$  ( $8.0 \sim 9.0 \text{ N.m}$ ,  $5.9 \sim 6.6 \text{ lb-ft}$ )

- 6. Connect the Passenger Airbag (PAB) harness connector to the SRS main harness connector.
- 7. Reinstall the golve box. (Refer to Body "Glove Box Housing".)
- 8. Reconnect the battery negative cable.
- 9. After installing the Passenger Airbag (PAB), confirm proper system operation:

### NOTICE

Turn the ignition switch ON; the SRS indicator light should be turned on for about six seconds and then go off.

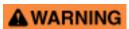
# **COMPONENTS**



2016 > Engine > G 1.2 MPI > Restraint > Airbag Module > Side Airbag (SAB) Module > Description and Operation

## **DESCRIPTION**

The two Side Airbags (SAB) are installed inside the driver and passenger seat and protects the driver and front passenger from danger when side crash occurs. The SRSCM determines deployment of side airbag by using Side Impact Sensor (SIS) signal.



Never attempt to measure the circuit resistance of the airbag module (squib) even if you are using the specified tester. If the circuit resistance is measured with a tester, accidental airbag deployment will result in serious personal injury.

#### **REMOVAL**

1. Disconnect the battery negative(-) cable.

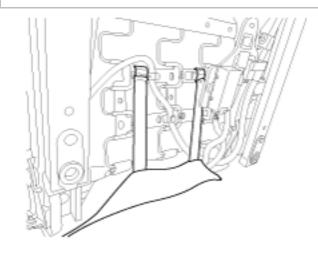


Wait for 3minutes before beginning work.

- 2. Remove the front seat assembly. (Refer to Body "Seat")
- 3. Remove the seat-back cover. (Refer to Body "Seat")
- 4. Loosen the SAB mounting nuts and remove the SAB module.

### **▲** CAUTION

The removed airbag module should be stored in a clean, dry place with the pad cover face up.



#### **INSTALLATION**



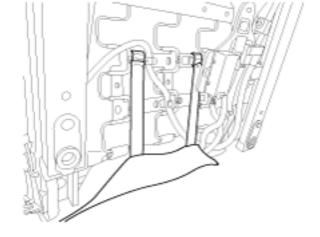
Be sure to install the harness wires not to be pinched or interfered with other parts.

### NOTICE

- Do not open the lid of the side airbag cover.
- Use a new mounting nuts when you replace a side airbag.
- Make sure that the seat-back cover is installed properly. Improper installation may prevent the proper deployment.
- 1. Remove ignition key from the vehicle.
- 2. Disconnect the battery negative cable and wait for at least three minutes.
- 3. Place a Side Airbag (SAB) on the seat-back frame and tighten the side airbag mounting nuts.

#### **Tightening torque**

: 11.7 ~ 14.7 Nm(1.2 ~ 1.5 kgf.m, 8.7 ~ 10.8 lb-ft)



- 4. Install the new seat-back cover. (Refer to Body "Seat")
- 5. Install the seat assembly, then connect the Side Airbag (SAB) harness connector.
- 6. Recline and slide the front seat forward fully, make sure the harness wires are not pinched or interfering with other parts.
- 7. Reconnect the battery negative(-) cable.
- 8. After installing the Side Airbag (SAB), confirm proper system operation:

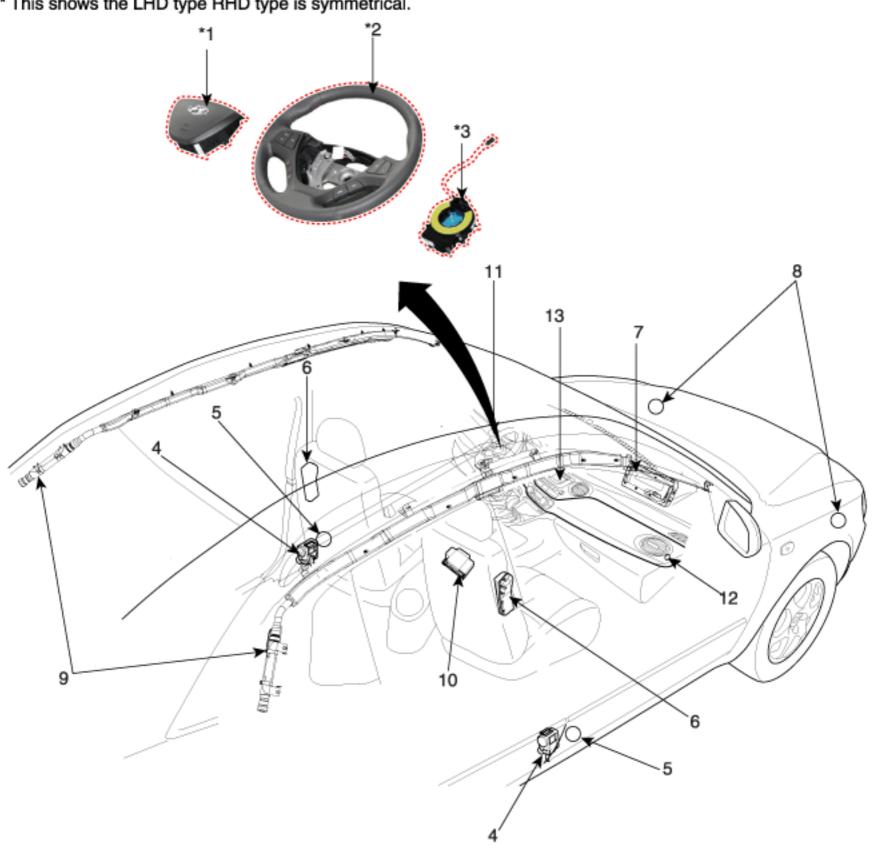


Turn the ignition switch ON; the SRS indicator light should be turned on for about six seconds and then go off.

## **COMPONENTS (1)**

### [LHD]

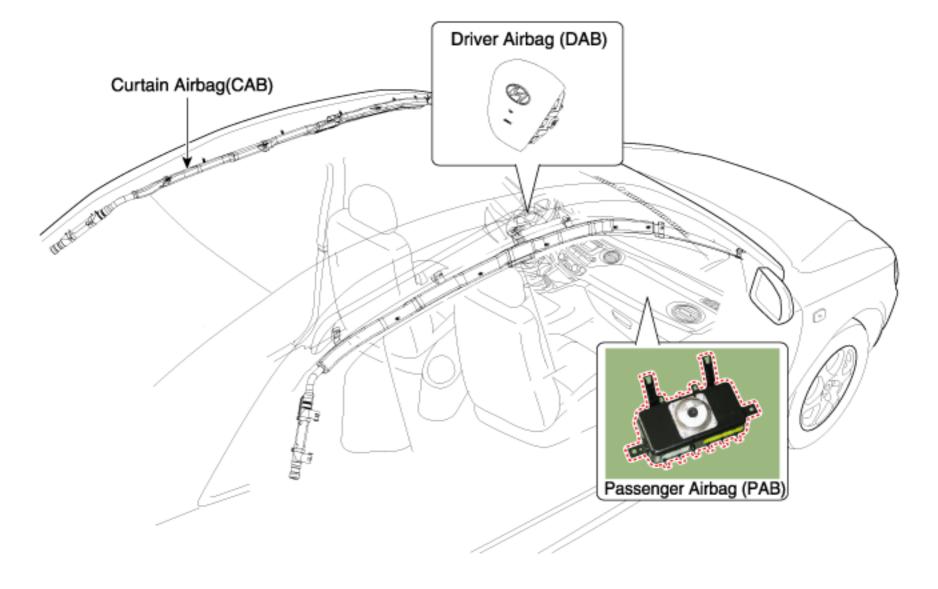
\* This shows the LHD type RHD type is symmetrical.



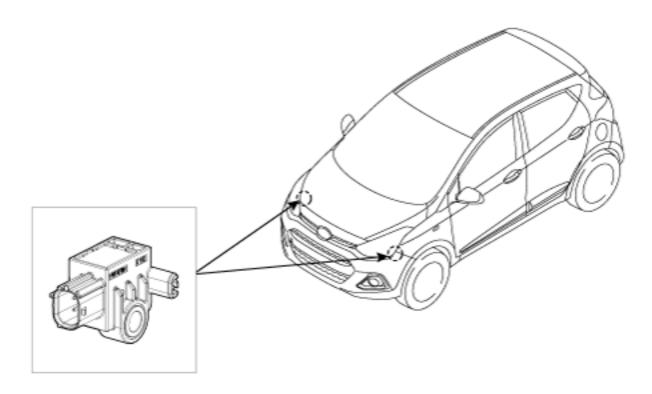
- 1. Driver Airbag (DAB)
- 2. Steering Wheel
- 3. Clock Spring
- 4. Seat Belt Pretensioner (BPT)
- 5. Side Impact Sensor (SIS)
- 6. Side Airbag (SAB)
- 7. Passenger Airbag (PAB)

- 8. Front Impact Sensor (FIS)
- 9. Curtain Airbag (CAB)
- 10. Supplemental Restraint System Control Module (SRSCM)
- 11. Airbag Warning Lamp
- 12. PAB ON/OFF Switch
- 13. PAB ON/OFF Lamp

## Curtain Airbag (DAB, PAB, CAB)

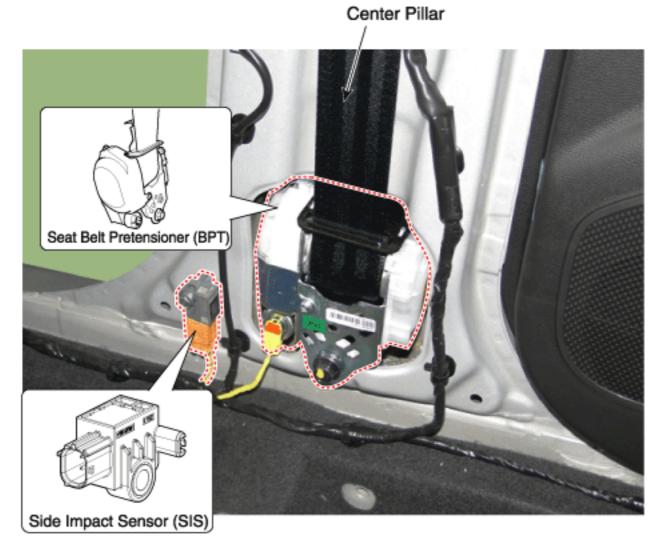


Front Impact Sensor (FIS)

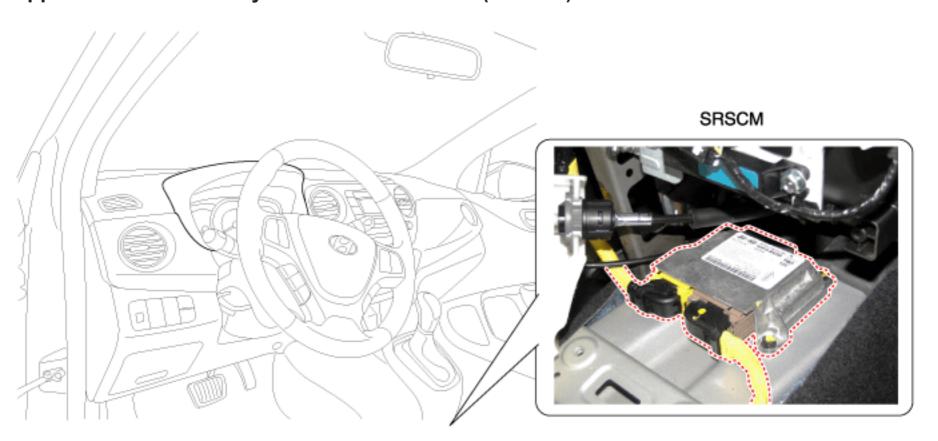


Front Impact Sensor (FIS)

Seat Belt Pretensioner (BPT) / Side Impact Sensor (SIS)



Supplemental Restrain System Control Module (SRSCM)

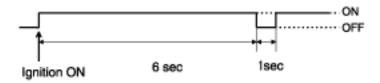


#### WARNING LAMP ACTIVATION

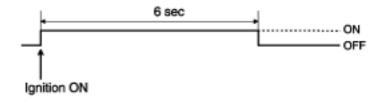
### Warning lamp behavior after ignition ON

As soon as the operating voltage is applied to the SRSCM ignition input, the SRSCM activates the warning lamp for a bulb check. The lamp shall turn on for 6 seconds during the initialization phase and be turned off afterward. However, in order to indicate the driver, the warning lamp shall turn on for 6 seconds and off for one second then on continuously after the operating voltage is applied if any active fault exists.

1. Active fault or historical fault counter is greater or equal to 10



2. Normal or historical fault counter is less than 10



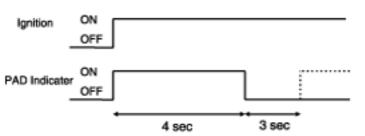
### SRSCM Independent warning lamp activation

There are certain fault conditions in which the SRSCM cannot function and thus cannot control the operation of the standard warning lamp is directly activated by appropriate circuitry that operates independently of the SRSCM. These cases are:

- 1. Loss of battery supply to the SRSCM: warning lamp turned on continuously.
- 2. Loss of internal operating voltage: warning lamp turned on continuously.
- 3. Loss of Microprocessor operation: warning lamp turned on continuously.
- 4. SRSCM not connected: warning lamp turned on continuously through the shorting bar.

## Passenger airbag deactivation (PAD) lamp operation

The SRSCM is designed with circuitry and software to drive a PAD lamp, which is used for depowered airbag system. For the PAD indicator circuitry to function properly, both the SRSCM and PAD indicator are sourced from the same ignition line. After ignition on, the PAD indicator will be turned on for 4 seconds and off for 3 seconds during the initialization phase. Thereafter the lamp will be turned on as long as the PAD switch is in the disabled position.



## Passenger restraints activation with PAD ON/OFF switch

The PAD ON/OFF switch affects the activation of the front passenger airbag only and the switch is controlled manually. The PAD ON/OFF switch will be functioned as follows:

PAD ON/OFF Switch status	PAD Lamp	PAB
Phase-up	$ON \to OFF$	Default
Enabled position	OFF	Enable

Disabled position	ON	Disable
Fault	Based on PAB	Default

### **GENERAL**

The supplemental restraint system (SRS) is designed to supplement the seat belt to help reduce the risk or severity of injury to the driver and passenger by activating and deploying the driver, passenger, side airbag and belt pretensioner in certain frontal or side collisions.

The SRS (Airbag) consists of: a driver side airbag module located in the center of the steering wheel, which contains the folded cushion and an inflator unit; a passenger side airbag module located in the passenger side crash pad contains the folded cushion assembled with inflator unit; side airbag modules located in the driver and passenger seat contain the folded cushion and an inflator unit; curtain airbag modules located inside of the headliner which contains folded cushions and inflator units. The impact sensing function of the SRSCM is carried out by electronic accelerometer that continuously measure the vehicle's acceleration and delivers a corresponding signal through amplifying and filtering circuitry to the microprocessor.

### SRSCM (SRS Control Module)

SRSCM will detect front impact with front impact sensor, and side impact with side impact sensor, and determine airbag module deployment.

- 1. DC/DC converter: DC/DC converter in power supply unit includes up/down transformer converter, and provide ignition voltage for 2 front airbag ignition circuits and the internal operation voltage of the SRSCM. If the internal operation voltage is below critical value setting, it will perform resetting.
- 2. Back up power supply: SRSCM has separate back up power supply, that will supply deployment energy instantly in low voltage condition or upon power failure by front crash.
- 3. Self diagnosis: SRSCM will constantly monitor current SRS operation status and detect system failure while vehicle power supply is on, system failure may be checked with trouble codes using scan tool. (Hi-Scan)
- 4. Airbag warning lamp on: Upon detecting error, the module will transmit signal to SRSCM indicator lamp located at cluster. MIL lamp will indicate driver SRS error. Upon ignition key on, SRS lamp will turn on for about six seconds.
- 5. Trouble code registration: Upon error occurrence in system, SRSCM will store DTC corresponding to the error. DTC can be cleared only by Hi-Scan. However, if an internal fault code is logged or if a crash is recorded thefault clearing should not happen.
- 6. Self diagnostic connector: Data stored in SRSCM memory will be output to Hi-Scan or other external output devices through connector located below driver side crash pad.
- 7. Once airbag is deployed, SRSCM should not be used again but replaced.
- 8. Side airbag deployment will be determined by SRSCM that will detect satellite sensor impact signal upon side crash, irrespective to seat belt condition.

#### **PRECAUTIONS**

### General precautions

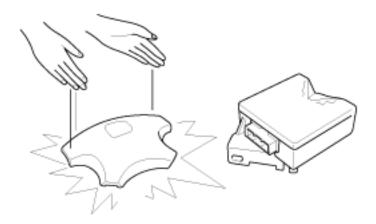
Please read the following precautions carefully before performing the airbag system service. Observe the instructions described in this manual, or the airbags could accidentally deploy and cause damage or injuries.

• Except when performing electrical inspections, always turn the ignition switch OFF and disconnect the negative cable from the battery, and wait at least three minutes before beginning work.

#### NOTICE

The contents in the memory is not erased even if the ignition switch is turned OFF or the battery cables are disconnected from the battery.

- Use the replacement parts which are manufactured to the same standards as the original parts and quality.
   Do not install used SRS parts from another vehicle.
   Use only new parts when making SRS repairs.
- Carefully inspect any SRS part before you install it.
   Do not install any part that shows signs of being dropped or improperly handled, such as dents, cracks or deformation.



 Before removing any of the SRS parts (including the disconnection of the connectors), always disconnect the SRS connector.

### Airbag handling and storage

Do not disassemble the airbags; it has no serviceable parts. Once an airbag has been deployed, it cannot be repaired or reused. For temporary storage of the air bag during service, please observe the following precautions.

- Store the removed airbag with the pad surface up.
- Keep free from any oil, grease, detergent, or water to prevent damage to the airbag assembly.



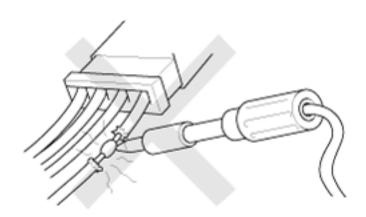
- Store the removed airbag on secure, flat surface away from any high heat source (exceeding 85°C/185°F).
- Never perform electrical inspections to the airbags, such as measuring resistance.
- Do not position yourself in front of the airbag assembly during removal, inspection, or replacement.
- Refer to the scrapping procedures for disposal of the damaged airbag.
- Be careful not to bump or impact the SRS unit or the side impact sensors whenever the ignition switch is ON, wait at least three minutes after the ignition switch is turned OFF before begin work.
- During installation or replacement, be careful not to bump (by impact wrench, hammer, etc.) the area around the SRS unit and the side impact sensor. The airbags could accidentally deploy and cause damage or injury.
- After a collision in which the airbags were deployed, replace the front airbags and the SRS unit. After a collision in
  which the side airbag was deployed, replace the side airbag, the front impact sensor and side impact sensor on the
  side where the side airbag deployed and the SRS unit. After a collision in which the airbags or the side air bags did
  not deploy, inspect for any damage or any deformation on the SRS unit and the side impact sensors. If there is any
  damage, replace the SRS unit, the front impact sensor and/or the side impact sensors.
- Do not disassemble the SRS unit, the front impact sensor or the side impact sensors
- Turn the ignition switch OFF, disconnect the battery negative cable and wait at least three minutes before beginning installation or replacement of the SRS unit.
- Be sure the SRS unit, the front impact sensor and side impact sensors are installed securely with the mounting bolts.
- Do not spill water or oil on the SRS unit, or the front impact sensor or the side impact sensors and keep them away from dust.
- Store the SRS unit, the front impact sensor and the side impact sensors in a cool (15 ~ 25°C/59 ~ 77°F) and dry (30% ~ 80% relative humidity, no moisture) area.

### Wiring precautions

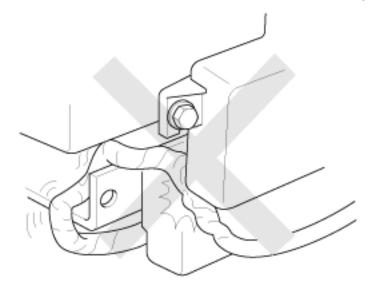
SRS wiring can be identified by special yellow outer covering.

Observe the instructions described in this section.

Never attempt to modify, splice, or repair SRS wiring.
 If there is an open or damage in SRS wiring, replace the harness.



• Be sure to install the harness wires so that they are not pinched, or interfere with other parts.

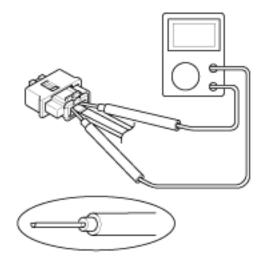


• Make sure all SRS ground locations are clean, and grounds are securely fastened for optimum metal-to-metal contact. Poor grounding can cause intermittent problems that are difficult to diagnose.

## Precautions for electrical inspections

• When using electrical test equipment, insert the probe of the tester into the wire side of the connector.

Do not insert the probe of the tester into the terminal side of the connector, and do not tamper with the connector.



- Use a u-shaped probe. Do not insert the probe forcibly.
- Use specificed service connectors for troubleshooting.
   Using improper tools could cause an error in inspection due to poor metal contact.

# Spring-loaded lock connector

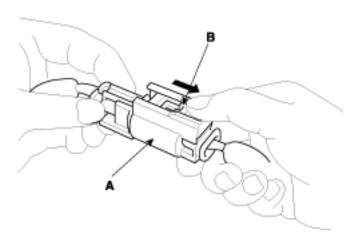
Some SRS system connectors have a spring-loaded lock.

## Airbag connector

## Disconnecting

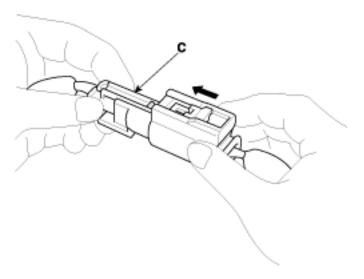
To release the lock, pull the spring-loaded sleeve (A) and the slider (B), while holding the opposite half of the connector. Pull the

connector halves apart. Be sure to pull on the sleeve and not on the connector half.



# Connecting

Hold both connector halves and press firmly until the projection (C) of the sleeve-side connector clicks to lock.



### COMPONENT REPLACEMENT AFTER DEPLOYMENT

## NOTICE

Before doing any SRS repairs, use the Hi-Scan Pro to check for DTCs. Refer to the Diagnostic Trouble Code list for repairing of the related DTCs.

When the front airbag(s) deployed after a collision, replace the following items.

- SRSCM
- Deployed airbag(s)
- Seat belt pretensioner(s)
- Front impact sensors
- SRS wiring harnesses
- Inspect the clock spring for heat damage.
   If any damage found, replace the clock spring.

When the side/curtain airbag(s) deployed after a collision, replace the following items.

- SRSCM
- Deployed airbag(s)
- Side impact sensor(s) for the deployed side(s)
- Deployed seat belt pretensioner(s) for the deployed side(s)
- SRS wiring harnesses

After the vehicle is completely repaired, confirm the SRS airbag system is OK.

Turn the ignition switch ON, the SRS indicator should come on for about 6 seconds and then go off.

## **SPECIAL SERVICE TOOLS**

Tool(Number and Name)	Illustration	Use
Deployment tool 0957A-34100A		Airbag deployment tool
Deployment adapter 0957A-2W100		Use with deployment tool. (SAB)
Deployment adapter 0957A-38500		Use with deployment tool. (DAB, PAB, CAB, BPT)
Dummy 0957A-38200		Simulator to check the resistance of each wiring harness
Dummy adapter 0957A-2W200		Use with dummy (SAB)
Dummy adapter 0957A-2G000		Use with dummy (DAB, PAB, CAB, BPT)

DAB : Driver Airbag

PAB : Passenger Airbag

SAB : Side Airbag CAB : Curtain Airbag BPT : Belt Pretensioner

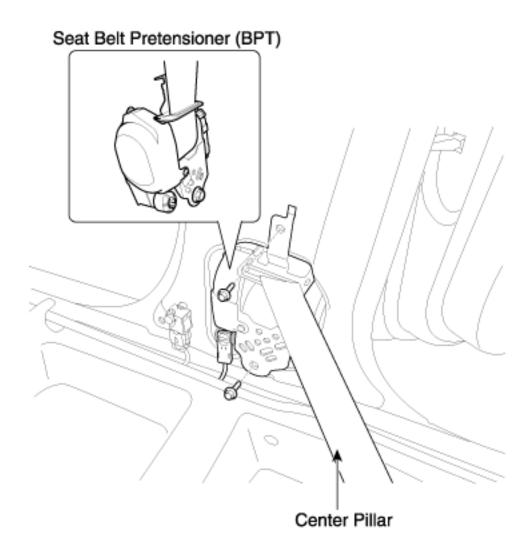
# **SPECIFICATION**

Item	Resistance (Ω)
Driver Airbag (DAB)	2.1 ~ 6.0
Passenger Airbag (PAB)	1.6 ~ 6.0
Side Airbag (SAB)	1.6 ~ 6.0
Curtain Airbag (CAB)	1.6 ~ 6.0
Seat Belt Pretensioner (BPT)	1.6 ~ 6.0

# **TIGHTENING TORQUES**

Item	Nm	kgf⋅m	lb-ft
Driver Airbag (DAB)	7.9 ~ 10.8	0.8 ~ 1.1	5.8 ~ 8.0
Passenger Airbag (PAB)	8.0 ~ 9.0	0.8 ~ 0.9	5.9 ~ 6.6
Curtain Airbag (CAB)	11.7 ~ 14.7	1.2 ~ 1.5	8.7 ~ 10.8
Side Airbag (SAB)	4.9 ~ 6.8	0.5 ~ 0.7	3.6 ~ 5.0
Seat Belt Anchor Bolt (BPT)	39.2 ~ 53.9	4.0 ~ 5.5	28.9 ~ 39.8
SRSCM Mounting Bolt	8.0 ~ 10	0.8 ~ 1.0	5.9 ~ 7.4
Front Impact Sensor (FIS) Mounting Bolt	8.0 ~ 10	0.8 ~ 1.0	5.9 ~ 7.4
Side Impact Sensor (SIS) Mounting Bolt	8.0 ~ 10	0.8 ~ 1.0	5.9 ~ 7.4

# **COMPONENTS**



2016 > Engine > G 1.2 MPI > Restraint > Seat Belt Pretensioner > Seat Belt Pretensioner (BPT) > Description and Operation

### **DESCRIPTION**

The Seat Belt Pretensioners (BPT) are installed inside Center Pillar (LH & RH). When a vehicle crashes with a certain degree of frontal impact, the pretensioner seat belt helps to reduce the severity of injury to the front seat occupants by retracting the seat belt webbing. This prevents the front occupants from thrusting forward and hitting the steering wheel or the instrument panel when the vehicle crashes.



Never attempt to measure the circuit resistance of the Seat Belt Pretensioner (BPT) even if you are using the specified tester. If the circuit resistance is measured with a tester, the pretensioner will be ignited accidentally. This will result in serious personal injury.

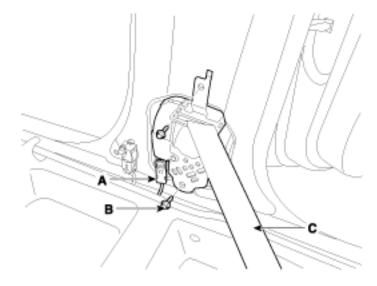
#### **REMOVAL**

1. Disconnect the battery negative(-) cable.



Wait for 3minutes before beginning work.

- 2. Remove the Center Pillar Trim and Door Scuff Trim.(Refer to Body "Interior Trim".)
- 3. Disconnect the Seat Belt Pretensioner connector (A).



- 4. Remove the lower anchor bolt (B).
- 5. Remove the Seat Belt Pretentioner(D) atter loosening the upper anchor bolt (C).

#### **INSTALLATION**

- 1. Remove ignition key from the vehicle.
- 2. Disconnect the negative (-) cable from battery and wait for at least three minutes.
- 3. Install the Seat Belt Pretensioner (BPT) with bolt.
- 4. Install the upper and lower anchor bolts.

#### **Tightening torque**

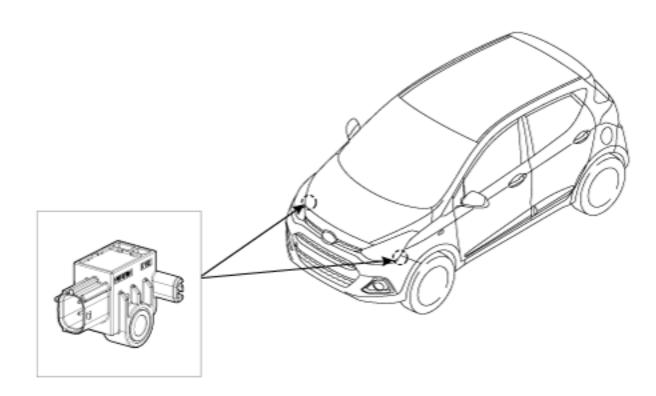
: 39.2 ~ 53.9 Nm(4.0 ~ 5.5 kgf.m, 28.9 ~ 39.8 lb-ft)

- 5. Remove the Center Pillar Trim and Door Scuff Trim.(Refer to Body "Interior Trim".)
- 6. Install the front seat assembly.
- 7. Reconnect the negative(-) battery cable.
- 8. After installing the Seat Belt Pretensioner (BPT), confirm proper system operation:

## NOTICE

Turn the ignition switch ON; the SRS indicator light should be turned on for about six seconds and then go off.

# COMPONENTS



Front Impact Sensor (FIS)

2016 > Engine > G 1.2 MPI > Restraint > SRSCM > Front Impact Sensor (FIS) > Description and Operation

## **DESCRIPTION**

The front impact sensors (FIS) are installed on the upper of the side panel in Front End Module(FEM). They are remote sensors that detect acceleration due to a collision at their mounting locations.

The primary purpose of the Front Impact Sensor (FIS) is to provide an indication of a collition. The Front Impact Sensor(FIS) sends acceleration data to the SRSCM.

#### **REMOVAL**

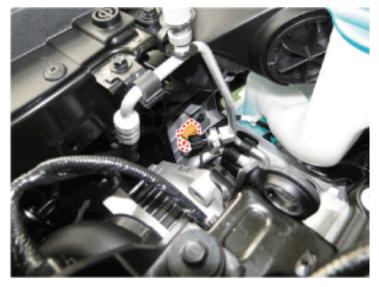
# **▲** CAUTION

- Removal of the airbag must be performed according to the precautions/ procedures described previously.
- Before disconnecting the front impact sensor connector, disconnect the front airbag connector(s).
- Do not turn the ignition switch ON and do not connect the battery cable while replacing the front impact sensor.
- 1. Disconnect the battery negative cable.

### **▲** WARNING

Wait for 3minutes before beginning work.

- 2. Remove the front wheel guard. (Refer to Body "Front Bumper cover".)
- 3. Disconnect the front impact sensor connector.
- 4. Loosen the front impact sensor mounting bolt and remove the front impact sensor.



#### **INSTALLATION**

# **▲** CAUTION

- Be sure to install the harness wire not to be pinched or interfere with other parts.
- Do not turn the ignition switch ON and do not contact the battery cable while replacing the front impact sensor.
- 1. Install the new Front Impact Sensor with bolt then connect the SRS harness connector to the Front Impact Sensor.

#### **Tightening torque**

 $: 8.0 \sim 10 \text{ Nm}(0.8 \sim 1.0 \text{kgf.m}, 5.9 \sim 7.4 \text{ lb-ft})$ 

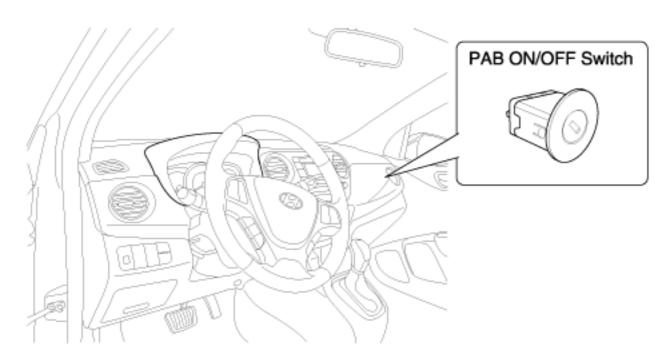
- 2. Install the front wheel guard.
- 3. Reconnect the negative battery cable.
- 4. After installing the Front Impact Sensor, confirm proper system operation:



Turn the ignition switch ON the SRS indicator light should be turned on for about six seconds and then go off.

# **COMPONENTS [LHD]**

\* This shows the LHD type RHD type is symmetrical.



## **DESCRIPTION**

Driver can control the passenger airbag operating Condition (Enable or Disable) by using this PAB ON/OFF switch. Passenger Airbag (PAB) ON/OFF Switch is installed in the crash pad side cover.

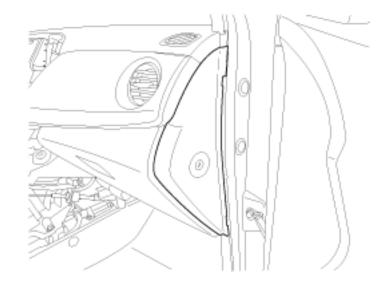
### **REMOVAL**

- 1. Remove the ignition key from the vehicle.
- 2. Disconnect the battery negative cable and wait for at least three minutes before beginning work.

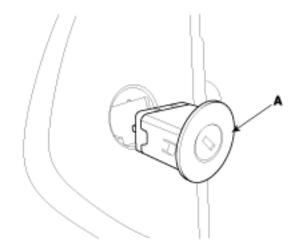


Wait for 3minutes before beginning work.

3. Remove the crash pad side cover. (Refer to Body - "Glove Box Housing".)



- 4. Disconnect the PAB ON/OFF switch connector.
- 5. Remove the PAB ON/OFF switch (A).



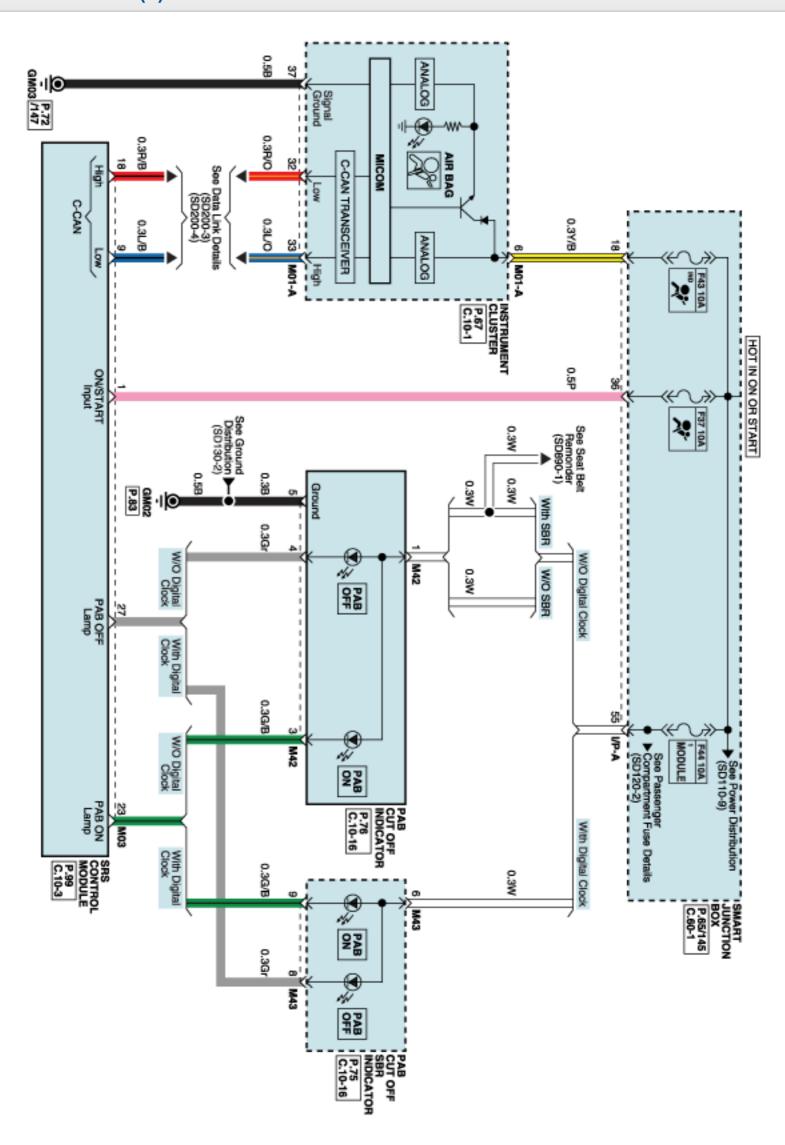
#### **INSTALLATION**

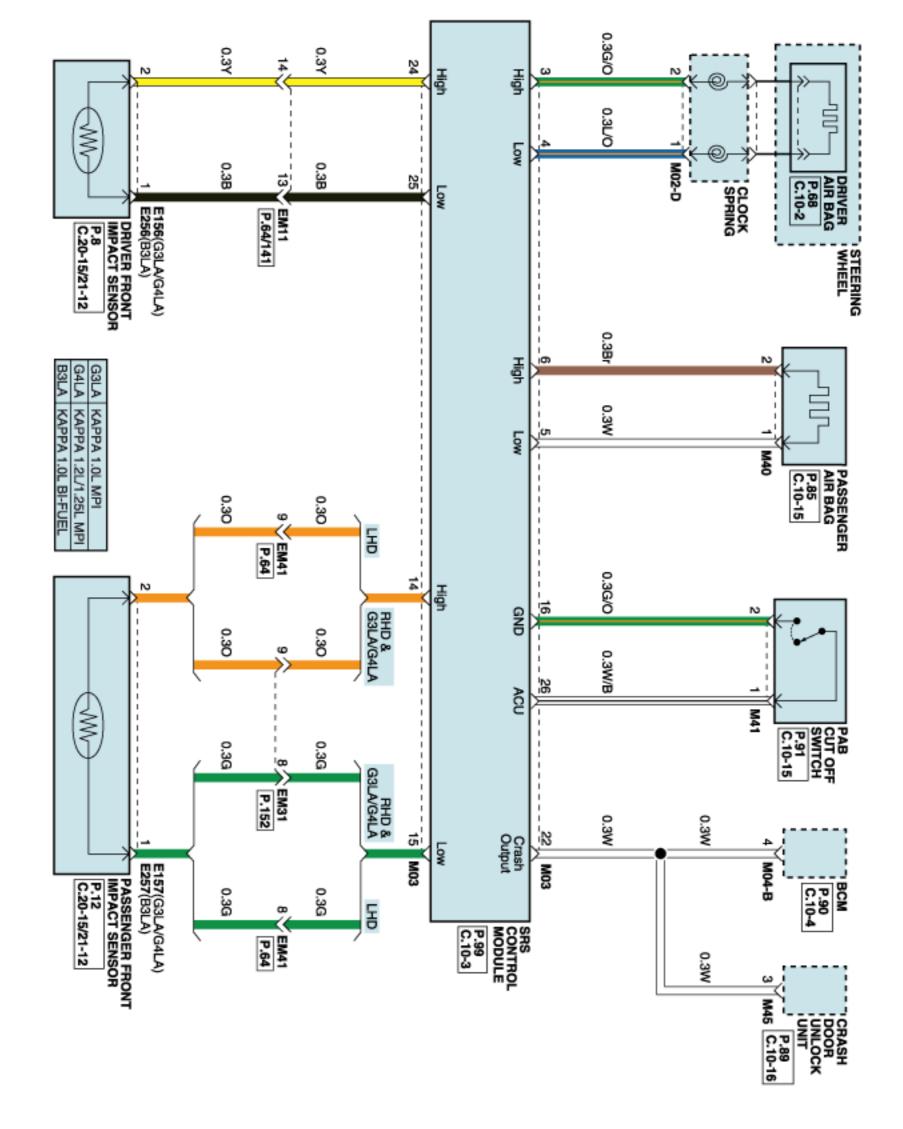
- 1. Remove the ignition key from the vehicle.
- 2. Disconnect the battery negative cable and wait for at least three minutes before beginning work.
- 3. Install the PAB ON/OFF switch to the crash pad side cover.
- 4. Connect the PAB ON/OFF switch connector to the crash pad side cover.
- 5. Install the crash pad side cover. (Refer to Body "Glove Box Housing".)
- 6. After installing the SRSCM, confirm proper system operation:

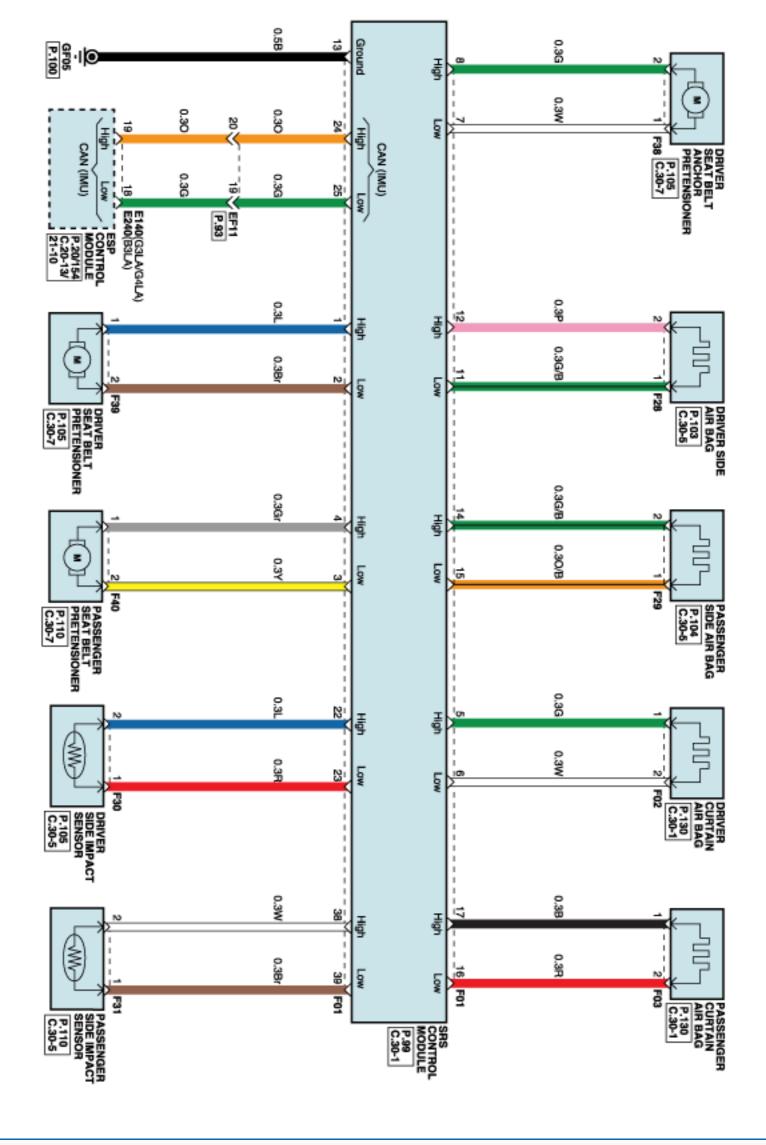


Turn the ignition switch ON; the SRS indicator light should be turned on for about six seconds and then go off.

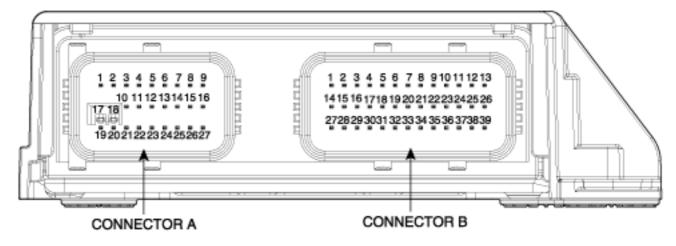
# **CIRCUIT DIAGRAM (1)**







## **SRSCM CONNECTOR TERMINAL**



PIN	FUNCTION		PIN
1	Ignition		1
2	-		2
3	Driver Airbag 1st Stage High(+)		3
4	Driver Airbag 1st Stage Low(-)		4
5	Passenger Airbag 1st Stage High(+)		5
6	Passenger Airbag 1st Stage Low(-)		6
7	-	В	7
8	-		8
9	CAN (ACU-Vehicle Low)		9
10	-		10
11	-		11
12	-		12
13	-		13
14	Passenger Front Impact Sensor (High)		14
15	Passenger Front Impact Sensor (Low)		15
16	Passenger Airbag Switch (Low)		16
17	-		17

Α

	PIN	FUNCTION			
	1	Retractor Pretentioner - Driver, Front (High)			
	2	Retractor Pretentioner - Driver, Front (Low)			
	3	Retractor Pretentioner - Passenger, Front(High)			
	4	Retractor Pretentioner - Passenger, Front(Low)			
	5	Driver Curtain Airbag(High)			
	6	Driver Curtain Airbag(Low)			
3	7	Anchor Pretentioner - Driver, Front(High)			
	8	Anchor Pretentioner - Driver, Front(Low)			
	9	-			
	10	-			
	11	Side Airbag - Driver, Front(High)			
	12	Side Airbag - Driver, Front(Low)			
	13	Ground			
	14	Side Airbag - Passenger, Front(High)			
	15	Side Airbag - Passenger, Front(Low)			
	16	Curtain Airbag - Passenger, Front(High)			
	17	Curtain Airbag - Passenger, Front(Low)			

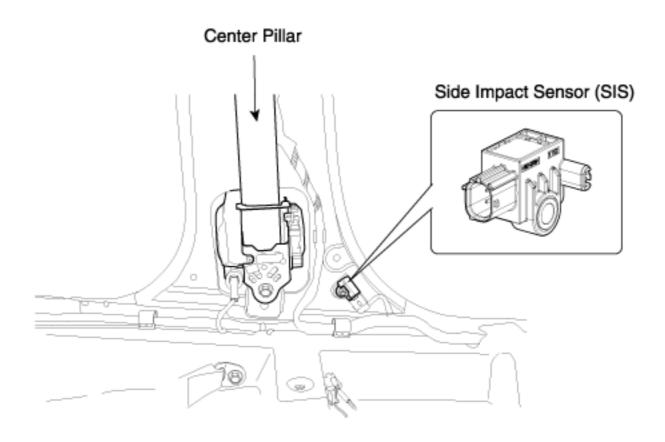
PIN	FUNCTION
18	CAN (ACU-Vehicle High)
19	-
20	-
21	-
22	Crash Output
23	Passenger Airbag Lamp On
24	Driver Front Impact Sensor (High)
25	Driver Front Impact Sensor (Low)
26	Passenger Airbag Switch (High)
27	Passenger Airbag Lamp Off

PIN	FUNCTION		
18	1		
19	-		
20	-		
21	-		
22	Side Impact Sensor - Driver, Front(High)		
23	Side Impact Sensor - Driver, Front(Low)		
24	CAN (IMU-ESC High)		
25	CAN (IMU-ESC Low)		
26	-		
27	-		

28		28	-
29	В	29	-
30		30	-
31		31	-
32		32	-
33		33	-
34		34	-
35		35	-
36		36	-
37		37	-
38		38	Side Impact Sensor - Passenger, Front (High)
39		39	Side Impact Sensor - Passenger, Front (Low)

A

## **COMPONENTS**



2016 > Engine > G 1.2 MPI > Restraint > SRSCM > Side Impact Sensor (SIS) > Description and Operation

## **DESCRIPTION**

The Side Impact Sensor (SIS) system consists of two front SIS which are installed inside the Center Pillar (LH and RH). They are remote sensors that detect acceleration due to collision at their mounting locations. The primary purpose of the Side Impact Sensor (SIS) is to provide an indication of a collision. The Side Impact Sensor (SIS) sends acceleration data to the SRSCM.

#### **REMOVAL**

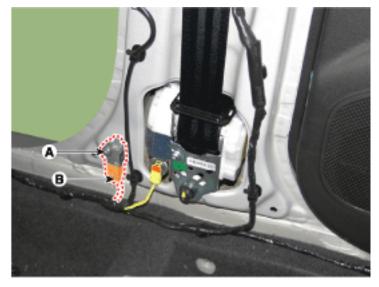
## **▲** CAUTION

- Removal of the airbag must be performed according to the precautions/procedures described previously.
- Before disconnecting the side impact sensor connector(s), disconnect the side airbag connector(s).
- Do not turn the ignition switch ON and do not connect the battery cable while replacing the side impact sensor.
- 1. Disconnect the battery negative cable.

### **AWARNING**

Wait for 3minutes before beginning work.

- 2. Remove the center Pillar Trim and Door Scuff Trim. (Refer to Body "Enter Pillar Trim".)
- 3. Disconnect the Side Impact Sensor connector (B).
- 4. Loosen the SIS mounting bolt and remove the Side Impact Sensor (A).



#### INSTALLATION

# **▲** CAUTION

- Be sure to install the harness wires not to be pinched or interfered with other parts.
- Do not turn the ignition switch ON and do not connect the battery cable while replacing the side impact sensor.
- 1. Install the new Side Impact Sensor with the bolt then connect the SRS harness connector to the Side Impact Sensor.

#### **Tightening torque**

:  $8.0 \sim 10 \text{ Nm}(0.8 \sim 1.0 \text{kgf.m}, 5.9 \sim 7.4 \text{ lb-ft})$ 

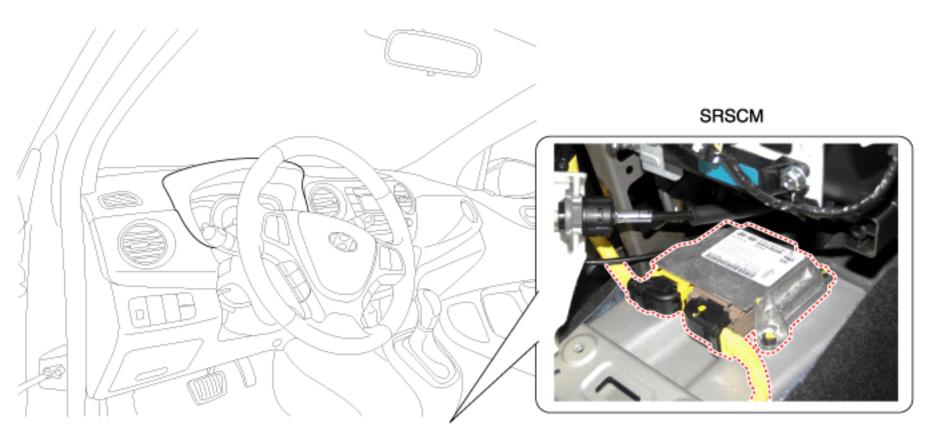
- 2. Remove the center Pillar Trim and Door Scuff Trim. (Refer to Body "Enter Pillar Trim".)
- 3. Reconnect the negative(-) battery cable.

4. After installing the Side Impact Sensor, confirm proper system operation:



Turn the ignition switch ON, the SRS indicator light should be turned on for about six seconds and then go off.

# **COMPONENTS**



2016 > Engine > G 1.2 MPI > Restraint > SRSCM > SRS Control Module (SRSCM) > Description and Operation

#### **DESCRIPTION**

The primary purpose of the SRSCM (Supplemental Restraints System Control Module) is to discriminate between an event that warrants restraint system deployment and an event that does not. The SRSCM must decide whether to deploy the restrain system or not. After determining that pretensioners and/or airbag deployment is required, the SRSCM must supply sufficient power to the pretensioners and airbag igniters to initiate deployment. The SRSCM determines that an impact may require deployment of the pretensioners and airbags from data obtained from impact sensors and other components in conjunction with a safing function. The SRSCM will not be ready to detect a crash or to activate the restraint system devices until the signals in the SRSCM circuitry stabilize. It is possible that the SRSCM could activate the safety restraint devices in approximately 2 seconds but is guaranteed to fully function after prove-out is completed. The SRSCM must perform a diagnostic routine and light a system readiness indicator at key-on. The system must perform a continuous diagnostic routine and provide fault annunciation through a warning lamp indicator in the event of fault detection. A serial diagnostic communication interface will be used to facilitate servicing of the restraint control system.

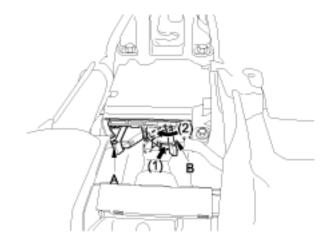
### **REMOVAL**

- 1. Remove ignition key from the vehicle.
- 2. Disconnect the negative (-) cable from battery.

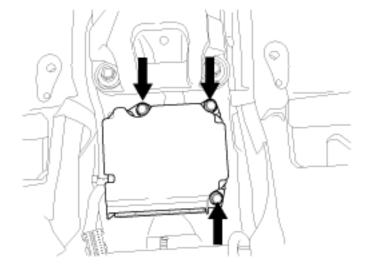
# **▲** WARNING

Wait for at least 3minutes before beginning work.

- 3. Disconnect the DAB, PAB, SAB, CAB and BPT connectors.
- 4. Remove the floor console. (Refer to Body "Floor console".)
- 5. Press the lock(1), then pull back the connector lever(2) until it clicks.



- 6. Disconnect the SRSCM harness connector(A) and (B) from the SRSCM.
- 7. Remove the SRSCM mounting nuts (3EA) from the SRSCM, then remove the SRSCM.



#### **INSTALLATION**

- 1. Remove ignition key from the vehicle.
- 2. Disconnect the negative (-) cable from battery.



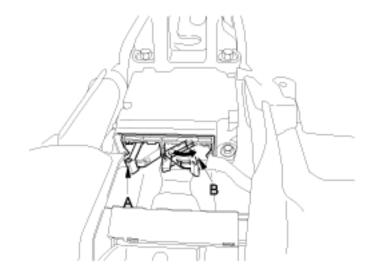
Wait for at least 3minutes before beginning work.

3. Install the SRSCM with the SRSCM mounting nuts.

### **Tightening torque**

 $: 8.0 \sim 10 \text{ Nm} (0.8 \sim 1.0 \text{kgf.m}, 5.9 \sim 7.4 \text{ lb-ft})$ 

4. Connect the SRSCM harness connector.

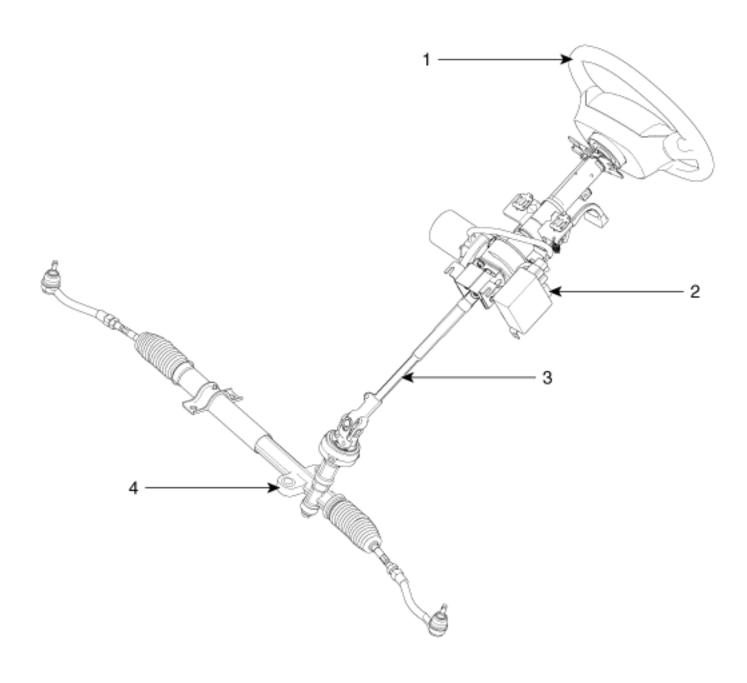


- 5. Install the floor console. (Refer to Body "Floor console".)
- 6. Connect the DAB, PAB, SAB, CAB and BPT connectors.
- 7. Reconnect the battery negative(-) cable.
- 8. After installing the SRSCM, confirm proper system operation:

### NOTICE

Turn the ignition switch ON; the SRS indicator light should be turned on for about six seconds and then go off.

## **COMPONENTS LOCATION**



- 1. Steering wheel
- 2. Steering column & EPS unit assembly

- 3. Universal joint assembly
- 4. Steering gear box

### **DESCRIPTION**

EPS (Electric power steering, Column assist type) system uses an electric motor to assist the steering force and it is an engine operation independent steering system.

EPS control module controls the motor operation according to information received from the each sensor and resulting in a more precise and timely control of steering assist than conventional engine-driven hydraulic systems.

Components (Torque Sensor, Fail-safe relay, etc.) of the EPS system are located inside the steering column & EPS unit assembly and the steering column & EPS unit assembly must not be disassemble to inspect or replace them.

### **Notes With Regard to Diagnosis**

Trouble factor	Check item	Trouble symtom	Explanation	Note
Drop, impact, and overload	Motor	Abnormal noise  Circuit damage  - Wrong welding point  - Broken PCB  - Damaged precise parts	<ul> <li>Visable or unvisable damage can occur. The steering wheel could pull to one side by using the dropped parts.</li> <li>Precise parts of motor/ECU are sensitive to vibration and impact.</li> <li>Overload can cause unexpected damage</li> </ul>	<ul><li>Do not use the impacted EPS.</li><li>Do not overload each parts.</li></ul>
	Torque sensor	Insufficient steering effort	Overload to INPUT shaft can cause malfunction of the torque sensor	<ul> <li>Do not impact the connecting parts (When inserting and torquing)</li> <li>Use the specified tool to remove the steering wheel. (Do not hammer on it)</li> <li>Do not use the impacted EPS</li> </ul>
	Shaft	Insufficient steering effort (Uneven between LH and RH)		Do not use the impacted EPS
Pull/Dent	Harness	<ul><li>Malfunction- impossible power operation</li><li>Malfunction of EPS</li></ul>	Disconnection between harness connecting portion and harness	Do not overload the harness
Abnormal storage temperature	Motor/ECU	Abnormal steering effort by improper operation of the motor/ECU	<ul> <li>Waterproof at the normal condition</li> <li>Even a little moisture can cause malfunction of the precise parts of the motor/ECU</li> </ul>	<ul> <li>Keep the normal temperature and proper moisture, while storaging</li> <li>Avoid drowning</li> </ul>

- 1. Do not impact the electronic parts, if they are dropped or impacted, replace them with new ones.
- 2. Avoid heat and moisture to the electronic parts.
- 3. Do not contact the connect terminal to avoid deformation and static electricity.
- 4. Do not impact the motor and torque sensor parts, if they are dropped or impacted, replace them with new ones.
- 5. The connector should be disconnected or connected with IG OFF.

#### **GENERAL INSPECTION**

After or before servicing the EPS system, perform the troubleshooting and test procedure as follows. Compare the system condition with normal condition in the table below and if abnormal symptom is detected, perform necessary remedy and inspection.

Test condition	Normal condition: Motor must not supply steering assist.				
Test condition    Normal condition: Motor must not supply steering assist.   Symptom   Possible cause   Remedy	Remedy				
IG Off		ASP is not calibrated.	Perform the ASP calibration using a scan tool.		
	steering assist.	IG power supplies	Perform the ASP calibration using a scatool.  Inspect the IG power supply line.		
	Nieuwe el e e e elitie e e	Material and a complete standing and a late Management	in a laws a in illustria at a d		

Test condition	Normal condition: Motor must not supply steering assist, Warning lamp is illuminated.			
	Symptom	Possible cause	Remedy	
	Wotor Supplies	ASP is not calibrated	Perform the ASP calibration using a scan tool.	
IG On/Engine Off	steering assist.	EMS CAN signal is not received.	Inspect the CAN line.	
	Warning lamp is not illuminated.	Cluster fault	Inspect the cluster and cluster harness	

Test condition	Normal condition: Motor supplies steering assist, Warning lamp is not illuminated.				
rest condition	Symptom	Possible cause	Remedy		
IG On/Engine On	Warning lamp is illuminated and Motor dose not	EPS (Hot at all times) and IG power supply fault	Inspect the connector and harness for EPS (Hot at all times) and IG power supply line.		
	supply steering assist.	DTC is detected by system.	Perform the self test using a scan tool and repair or replace.		
	Warning lamp is illuminated and	ASP is not calibrated.	Perform the ASP calibration using a scan tool.		
	Motor supplies steering assist.	CAN communication between EPS and cluster is fault.	Inspect the CAN line.		
	illuminated and Motor supplies	CAN communication between EPS and	tool.		

ASP: Absolute Steering Position
CAN: Controller Area Network
EMS: Engine Management System

## **▲** CAUTION

The following symptoms may occur during normal vehicle operation and if there is no EPS warning light illumination, it is not malfunction of EPS system.

- After turning the ignition switch on, the steering wheel becomes heavier while it performs EPS system diagnostics, for about 2 seconds, then it becomes normal steering condition.
- After turning the ignition switch on or off, EPS relay noise may occur but it is normal.
- When it is steered, while the vehicle is stopped or in low driving speed, motor noise may occur but it is normal operating one.

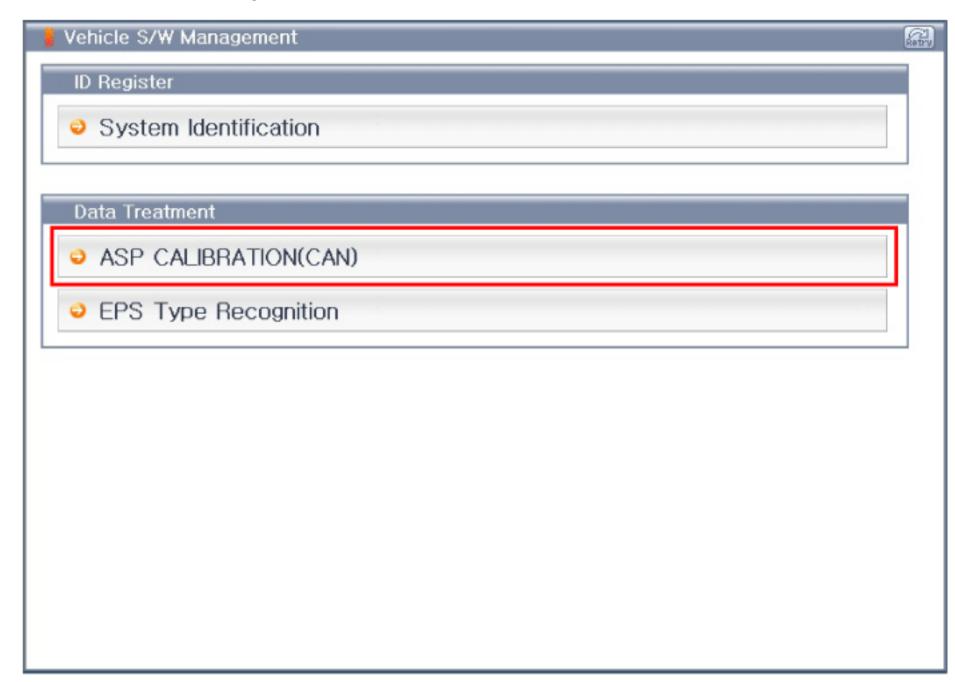
### Caution when ASP (Absolute Steering Position) calibration or EPS type recognition

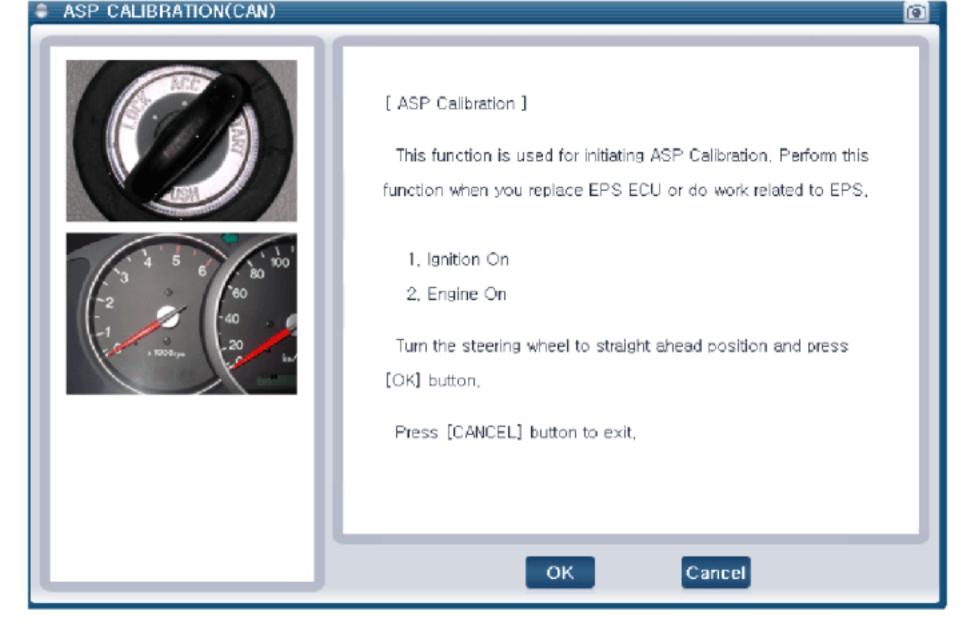
• Check if the battery is fully charged before ASP calibration or EPS type recognition.

- Be careful not to disconnect any cables connected to the vehicle or scan tool during ASP calibration or EPS type recognition.
- When the ASP calibration or EPS type recognition is completed, turn the ignition switch off and wait for several seconds, then start the engine to confirm normal operation of the vehicle.

# **ASP Calibration**

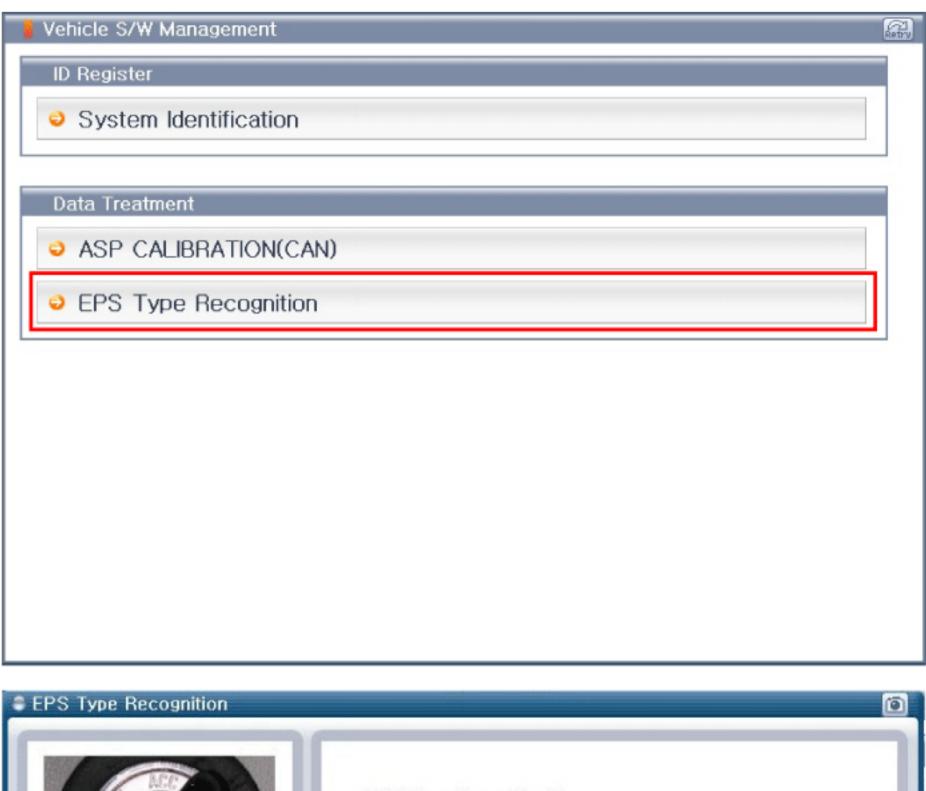
- 1. Select "Steering Angle Sensor".
- 2. Proceed with the test according to the screen introductions.

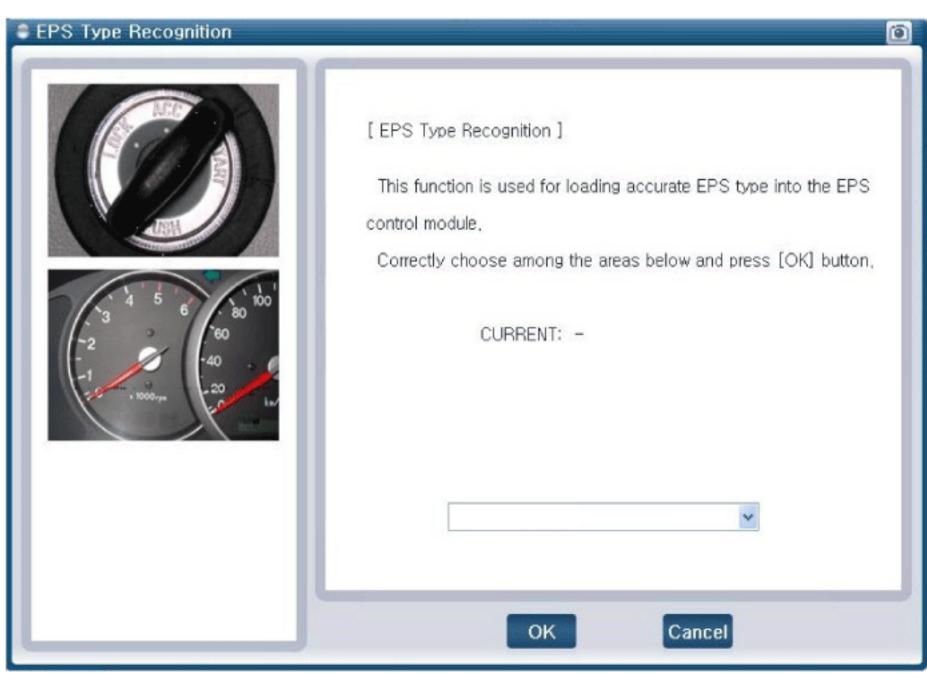




# **EPS Type Recognition Procedure**

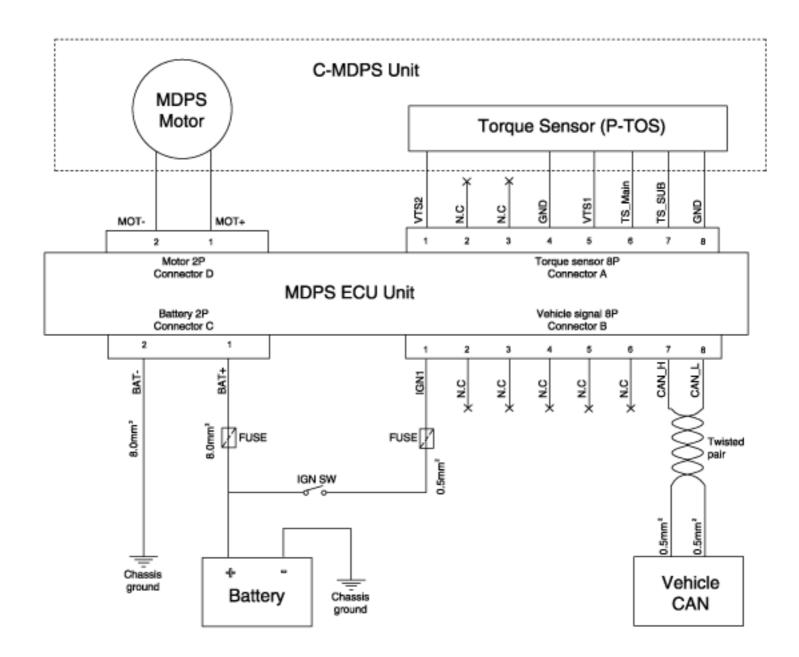
- 1. Select "EPS Variant Coding".
- 2. Proceed with the test according to the screen introductions.



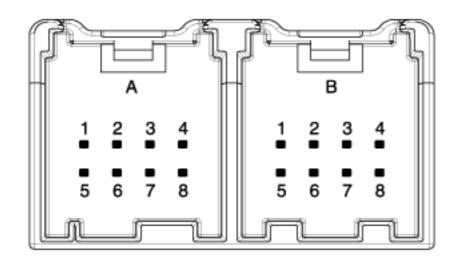


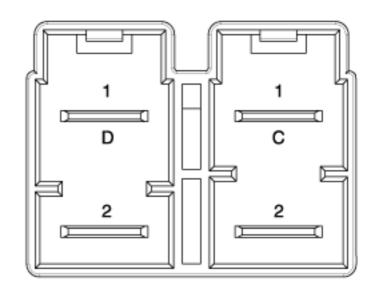
### **SCHEMATIC DIAGRAMS**

# **MDPS Circuit Diagram**



#### **Harness Connector**





Connector	Pin#	Pin Name	Description	Specification
	1	VTS2	SENT2 Supply Voltage	-

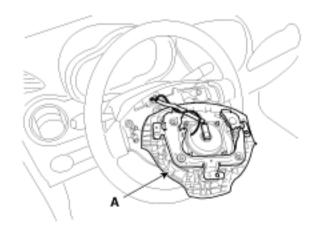
	2	N.C	Not Connected	-
ļ	3	N.C	Not Connected	-
TASensor Signal 8P Connector A	4	GND	VTS2 GND	-
	5	VTS1	SENT1 Supply Voltage	-
	6	TS_MAIN	SENT1 Signal	-
	7	TS_SUB	SENT2 Signal	-
	8	GND	VTS1 GND	
	1	IGN1	Ignition Signal	ECU Operating Voltage : 9.0V ~ 16.0V
	2	N.C	Not Connected	
	3	N.C	Not Connected	
Vehicle	4	N.C	Not Connected	
Signal 8P Connector B	5	N.C	Not Connected	
	6	N.C	Not Connected	
	7	CAN H	CAN BUS High Line	Reference to HMC ES95480-00
	8	CAN L	CAN BUS Low Line	Reference to HMC ES95480-00
Battery 2P Connector C	1	BAT +	Battery Positive	ECU Operating Voltage : 9.0V ~ 16.0V Peak I < 65A @ DC12V, MDPS Full Operation Leakage I < 0.5mA @ DC12V, MDPS OFF
ļ	2	BAT -	Chassis Ground	-
Motor 2P	1	MOT +	Motor Wire	
Connector D	2	MOT -	Motor Wire	-

### **REPLACEMENT**

- 1. Disconnect the battery negative cable from the battery and then wait for at least 30 seconds.
- 2. Turn the steering wheel so that the front wheels can face straight ahead.
- 3. Loosen the torx bolts which are located on the both side of the steering wheel.



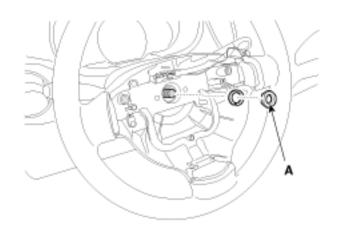
4. Disconnect the connector and then remove the airbag module (A) from the steering wheel.

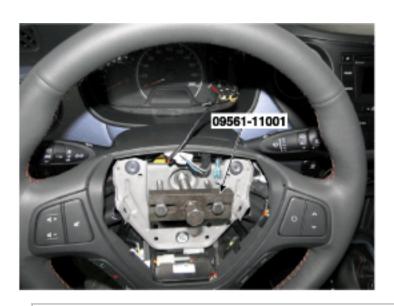


5. Disconnect the connector & lock nut (A) and then remove the steering wheel (B) by using special service tools (09561-11001).

#### **Tightening torque:**

39.2 ~ 49.0 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.2 lb-ft)

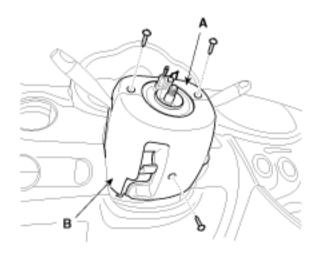




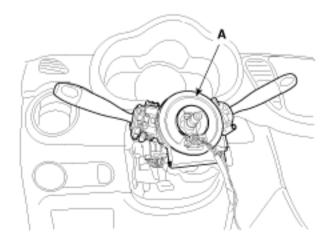
# NOTICE

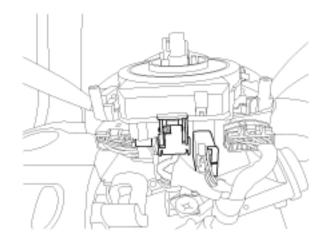
Do not hammer on the steering wheel to remove it; it may damage the steering column.

6. Loosen the screw and then remove the steering column upper (A) and lower shroud (B).

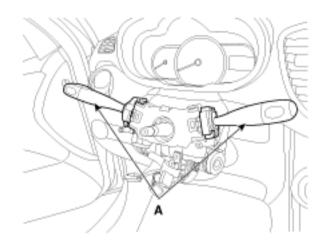


7. Remove the clock spring (A) from the steering column shaft.





8. Remove the multifunction swiches (A) from the steering column shaft.



Remove the crash pad lower penel (A).[LHD]



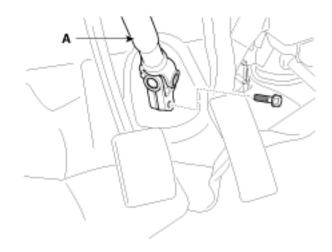
[RHD]



10. Loosen the bolt (A) and then disconnect the universal joint assembly from the pinion of the steering gear box.

### Tightening torque:

 $32.4 \sim 37.3 \text{ N.m}(3.3 \sim 3.8 \text{ kgf.m}, 23.9 \sim 27.5 \text{ lb-ft})$ 



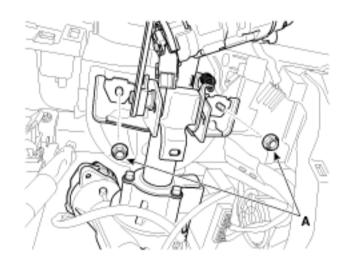
# NOTICE

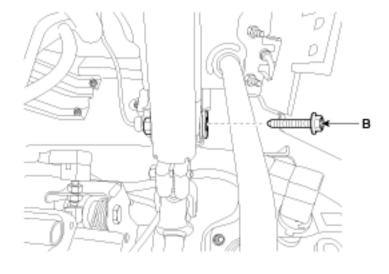
Lock the steering wheel in the straight ahead position to prevent the damage of the clock spring inner cable when you handle the steering wheel.

- 11. Disconnect all connectors connected the steering column & EPS unit assembly.
- 12. Remove the steering column & EPS control module by loosening the mounting bolt (B) and nuts (A).

#### **Tightening torque:**

Nut: 12.7 ~ 17.7 N.m(1.3 ~ 1.8 kgf.m, 9.4 ~ 13.0 lb-ft) Bolt: 44.1 ~ 49.0 N.m(4.5 ~ 5.0 kgf.m, 32.5 ~ 36.2 lb-ft)

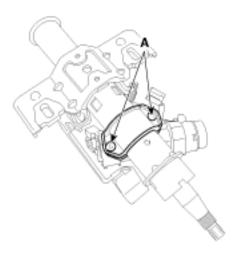




#### **DISASSEMBLY**

## Key lock assembly

1. Make a groove on the head of special bolts (A) by a punch.



- 2. Loosen the special bolt using a screw driver and then remove the key lock assembly from the steering column assembly.
- 3. Reassembly is the reverse of the disassembly.

### Universal joint assembly

1. Loosen the bolt (A) and then disconnect the universal joint assembly from the steering column assembly.

#### **Tightening torque:**

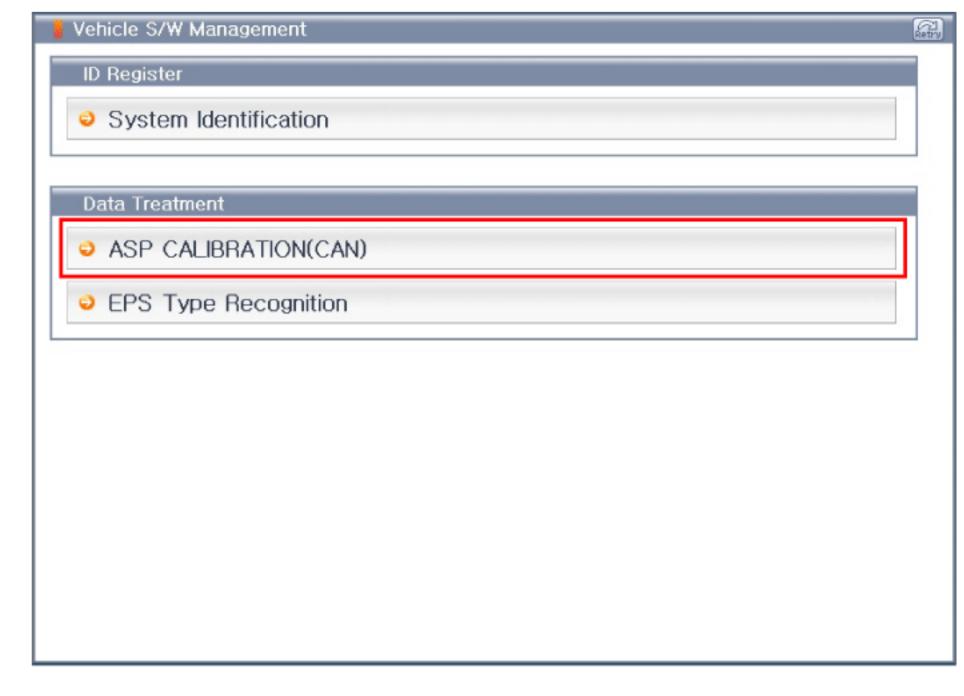
17.7 ~ 24.5 N.m(1.8 ~ 2.5 kgf.m, 13.0 ~ 18.1 lb-ft)



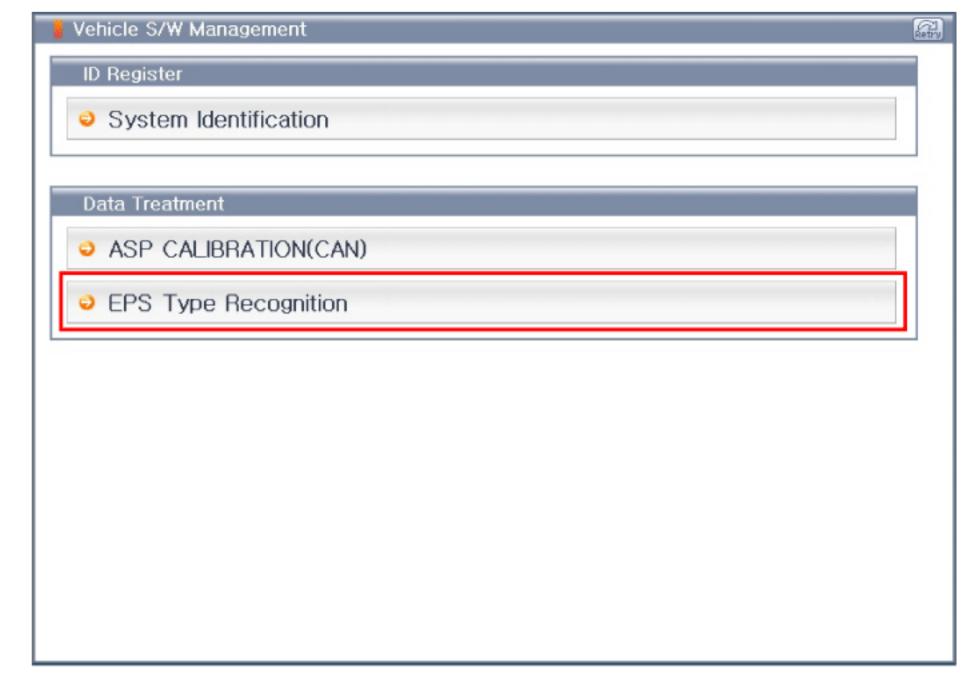
2. Reassembly is the reverse of the disassembly.

### **INSTALLATION**

- 1. Installation is the reverse of the removal.
- 2. Connect the diagnostic instrument to the self-diagnostic connector (16-pin) beneath the crash pad on the side of driver's seat, and then turn on the ignition to activate the diagnostic instrument.
- 3. In the GDS Vehicle Type Selection menu, select "Vehicle Type" and "EPS" System, and then opt for "OK."
- 4. Select the ASP Calibration
- 5. Proceed with the test according to the screen introductions.



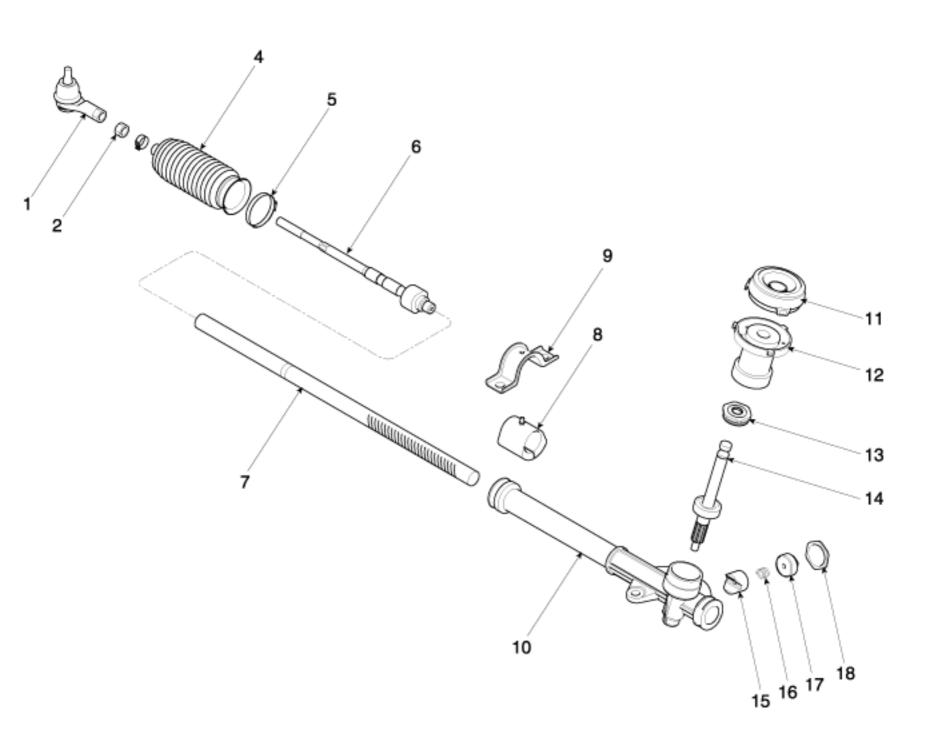
- 6. Select "EPS Variant Coding".
- 7. Proceed with the test according to the screen introductions.



### **INSPECTION**

- 1. Check the steering column for damage and deformation.
- 2. Check the join bearing for damage and wear.
- 3. Check the tilt bracket for damage and cracks.
- 4. Check the key lock assembly for proper operation and replace it if necessary.

## **COMPONENTS**



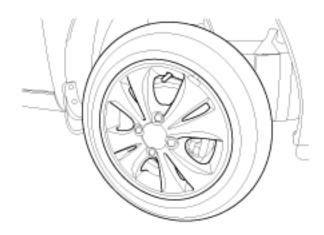
1. Tie-rod end	7. Rack bar	13. Pinion plug
2. Lock nut	8. Mounting rubber	14. Pinion
3. Bellows clip	9. Mounting clamp	15. Support yoke
4. Bellows	10. Rack housing	16. Yoke spring
5. Bellows band	11. Dust packing	17. Yoke plug
6. Tie-rod	12. Dust cap	18. Lock nut

#### **REPLACEMENT**

1. Remove the front wheel & tire.

### Tightening torque:

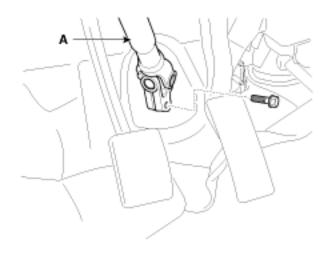
90.0 ~ 110.0 Nm (9.0 ~ 11.0 kgf.m, 65.0 ~ 80.0 lb-ft)



2. Loosen the bolt and then disconnect the universal joint assembly (A) from the pinion of the steering gear box.

### Tightening torque:

33.0 ~ 38.0 Nm (3.3 ~ 3.8 kgf.m, 24.0 ~ 27.0 lb-ft)



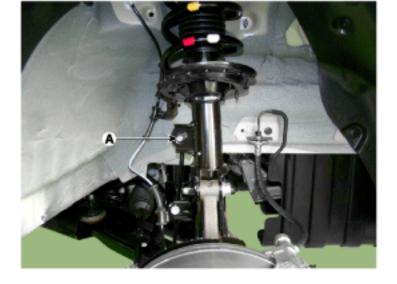
### NOTICE

Keep the neutral-range to prevent the damage of the clock spring inner cable when you handlethe steering wheel.

3. Loosen the nut and then disconnect the stabilizer link (A) from the front strut assembly.

### Tightening torque:

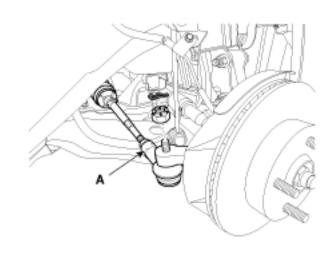
55.0 ~ 65.0 Nm (5.5 ~ 6.5 kgf.m, 40.0 ~ 47.0 lb-ft)



4. Remove the sprit pin, castle nut and then disconnect the tie rod end (A) from the front knuckle.

### Tightening torque:

16.0 ~ 34.0 Nm (1.6 ~ 3.4 kgf.m, 12.0 ~ 25.0 lb-ft)

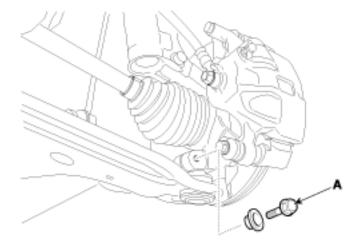




5. Remove the bolt (A) and then disconnect the lower arm with the knuckle.

### Tightening torque:

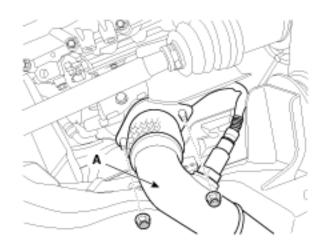
60.0 ~ 72.0 Nm (6.0 ~ 7.2 kgf.m, 43.0 ~ 52.0 lb-ft)



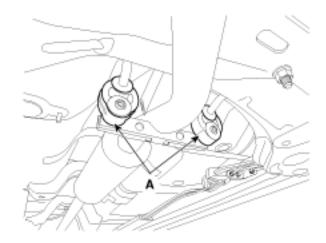
6. Remove the front muffler (A).

## Tightening torque:

40.0 ~ 55.0 Nm (4.0 ~ 5.5 kgf.m, 29.0 ~ 40.0 lb-ft)



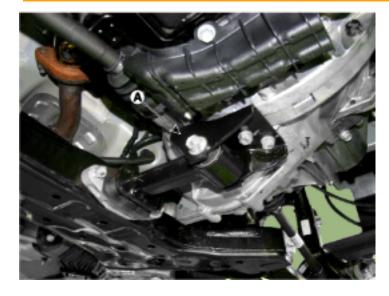
7. Remove the rubber hanger (A).



8. Loosen the bolt & nut and then remove the roll stopper (A).

### **Tightening torque:**

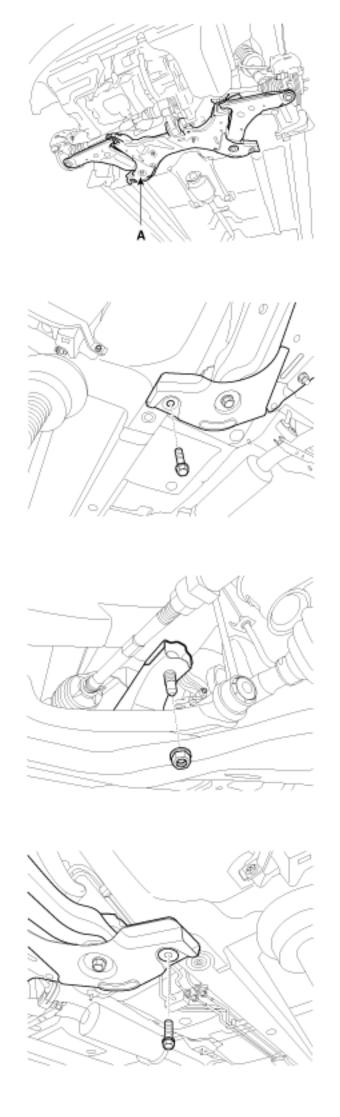
 $50.0 \sim 65.0 \text{ Nm} (5.0 \sim 6.5 \text{ kgf.m}, 36.0 \sim 47.0 \text{ lb-ft})$ 

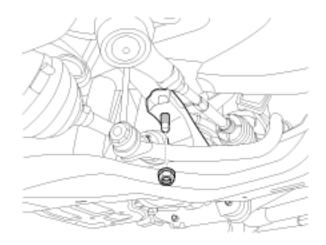


9. Remove the cross member (A) from the body by loosening the mounting bolts and nuts.

### **Tightening torque:**

160.0 ~ 180.0 Nm (16.0 ~ 18.0 kgf.m, 116.0 ~ 130.0 lb-ft)





10. Remove the heater protect (A) by loosening the bolts.

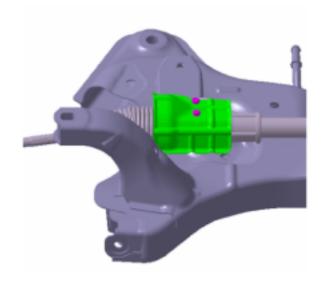
# Tightening torque :

 $7.0 \sim 11.0 \text{ N.m} (0.7 \sim 1.1 \text{ kgf.m}, 5.0 \sim 8.0 \text{ lb-ft})$ 

## [RHD]



[LHD]



11. Remove the steering gear box (A) from the cross member by loosen the mounting bolts.

## Tightening torque:

90.0 ~ 110.0 N.m (9.0 ~ 11.0 kgf.m, 65.0 ~ 80.0 lb-ft)



12. Installation is the reverse of removal.

# **SPECIAL TOOLS**

Tool(Number and Name)	Illustration	Use
09561-11002 Steering wheel puller		Remove the steering wheel
09568-34000		Joint remover

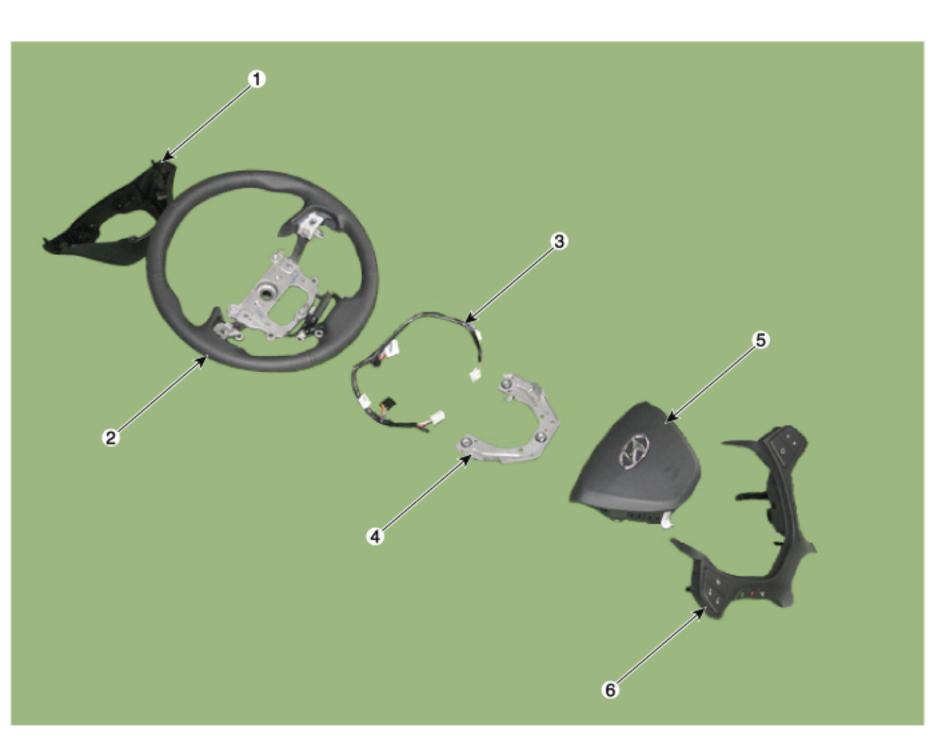
# **GENERAL**

ltem			Specification
Туре			Electronic Power Steering
Steering gear	Туре		Rack & Pinion
	Rack stroke	MDPS	148 ± 1mm (5.8268 ± 0.0394in)
	Rack Stroke	Manual	

# Tightening Torques

Items		Tightening torque			
		Nm	kgf.m	lb-ft	
Hub nuts		90.0 ~ 110	9.0 ~ 11.0	65.0 ~ 80.0	
Steering wheel lock nu	ut	40.0 ~ 50.0	4.0 ~ 5.0	29.0 ~ 36.0	
Steering column mounting nuts		13.0 ~ 18.0	1.3 ~ 1.8	9.4 ~ 13.0	
Steering column mounting bolts		45.0 ~ 50.0	4.5 ~ 5.0	33.0 ~ 36.0	
Bolt connecting universal joint	to pinion	33.0 ~ 38.0	3.3 ~ 3.8	24.0 ~ 27.0	
Bolt connecting steering column to	Manual	33.0 ~ 38.0	3.3 ~ 3.8	24.0 ~ 27.0	
universal joint	MDPS	33.0 ~ 38.0	3.3 ~ 3.8	24.0 ~ 27.0	
Steering gear to sub-fra	me	60.0 ~ 80.0	9.0 ~ 11.0	43.0 ~ 58.0	
Tie rod end castle nut		24.0 ~ 34.0	2.4 ~ 3.4	17.0 ~ 25.0	
Stabilizer link nut		100.0 ~ 120.0	10.0 ~ 12.0	72.0 ~ 87.0	
Lower arm to knuckle	;	60.0 ~ 72.0	6.0 ~ 7.2	43.0 ~ 52.0	

# **COMPONENTS**



- 1. Lower cover
- 2. Steering wheel
- 3. Wiring

- 4. Airbag module bracket
- 5. Airbag module
- 6. Remote control assembly

Steering wheel >

## **REPLACEMENT**

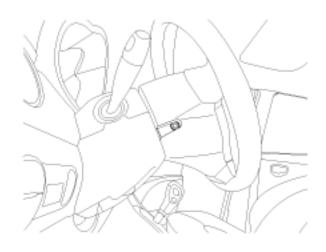
- 1. Disconnect the battery negative cable from the battery and then wait for at least 30 seconds.
- 2. Turn the steering wheel so that the front wheels can face straight ahead.
- 3. Loosen the steering wheel torx bolts which are located on the both side of the steering wheel.

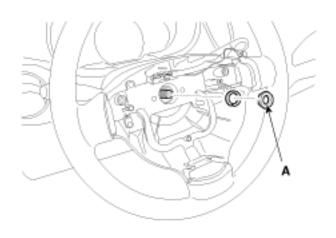


4. Disconnect the connector & lock nut (A) and then remove the steering wheel using special service tools (09561-11001).

### **Tightening torque:**

39.2 ~ 49.0 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.2 lb-ft)







## NOTICE

Do not hammer on the steering wheel to remove it; it may damage the steering column.

5. Installation is the reverse of the removal.

### **DISASSEMBLY**

1. Loosen the screw and then remove the lower cover (A) from the steering wheel body.



2. Disconnect the all of connector and then remove the wiring (A) from steering wheel.

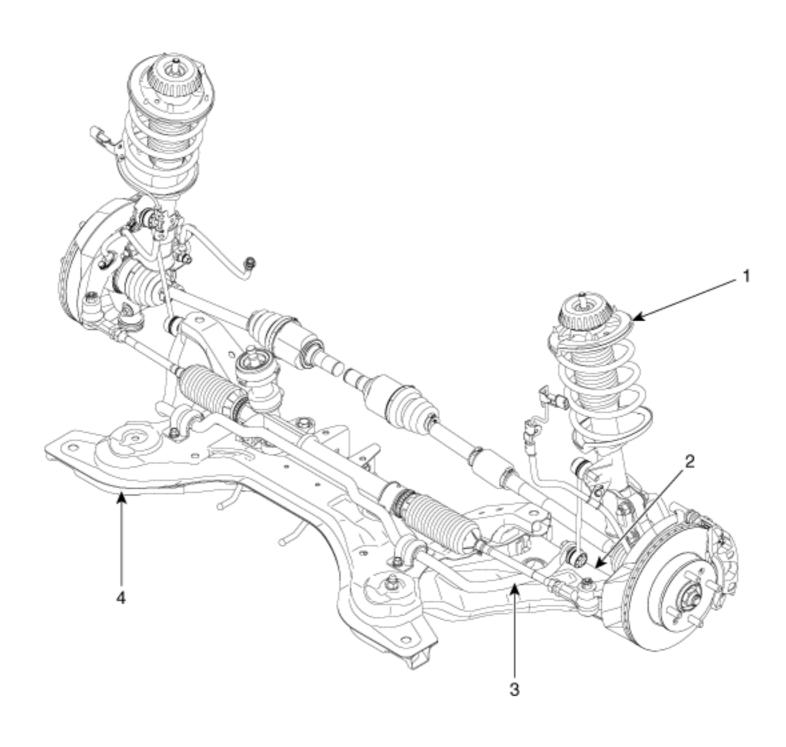


3. Loosen the screw and then remove the remote control switch assembly (A) from the steering wheel.



4. Installation is the reverse of the removal.

# **COMPONENTS LOCATION**



1.	Front	strut	assem	bl	У
----	-------	-------	-------	----	---

2. Front lower arm

3. Front stabilizer

4. Cross member

#### **REPLACEMENT**

1. Remove the front wheel & tire.

#### **Tightening torque:**

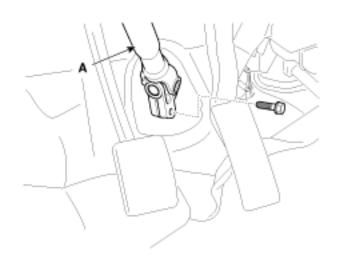
90.0 ~ 110.0 Nm (9.0 ~ 11.0 kgf.m, 65.0 ~ 80.0 lb-ft)



2. Loosen the bolt and then disconnect the universal joint assembly (A) from the pinion of the steering gear box.

### **Tightening torque**

Manual :  $13.0 \sim 18.0 \text{ Nm}$  ( $1.3 \sim 1.8 \text{ kgf.m}$ ,  $9.4 \sim 12.3 \text{ lb-ft}$ ) MDPS :  $33.0 \sim 38.0 \text{ Nm}$  ( $3.3 \sim 3.8 \text{ kgf.m}$ ,  $24.0 \sim 27.0 \text{ lb-ft}$ )



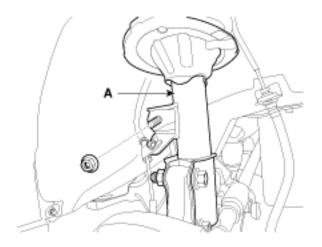
### NOTICE

Keep the neutral-range to prevent the damage of the clock spring inner cable when you handlethe steering wheel.

3. Disconnect the stabilizer link with the front strut assembly (A).

#### **Tightening torque:**

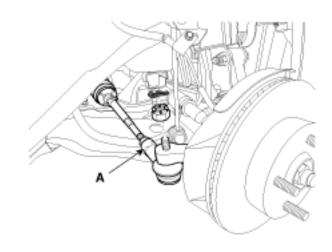
50.0 ~ 65.0 N.m (5.0 ~ 6.5 kgf.m, 36.0 ~ 47.0 lb-ft)

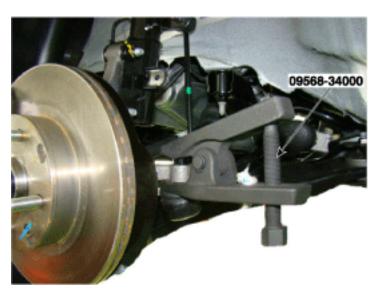


4. Remove the sprit pin and castle nut and then disconnect the tie-rod end (A) from the front knuckle.

### Tightening torque:

24.0 ~ 34.0 N.m (2.4 ~ 3.4 kgf.m, 17.0 ~ 25.0 lb-ft)

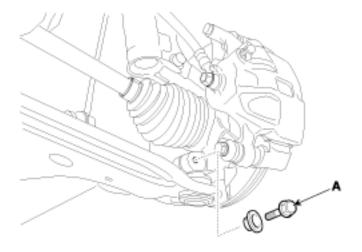




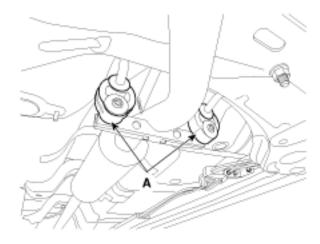
5. Remove the bolt (A) & nut and then disconnect the lower arm with the knuckle.

### Tightening torque:

 $60.0 \sim 72.0 \text{ Nm} (6.0 \sim 7.2 \text{ kgf.m}, 43.0 \sim 52.0 \text{ lb-ft})$ 



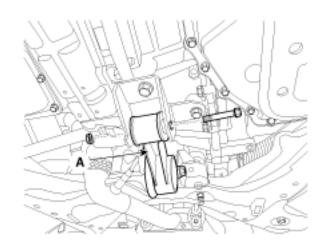
6. Remove the rubber hanger (A).



7. Loosen the bolt & nut and then remove the roll stopper (A).

## **Tightening torque:**

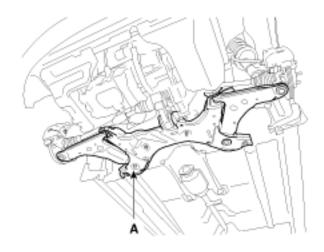
50.0 ~ 65.0 N.m (5.0 ~ 6.5 kgf.m, 36.0 ~ 47.0 lb-ft)

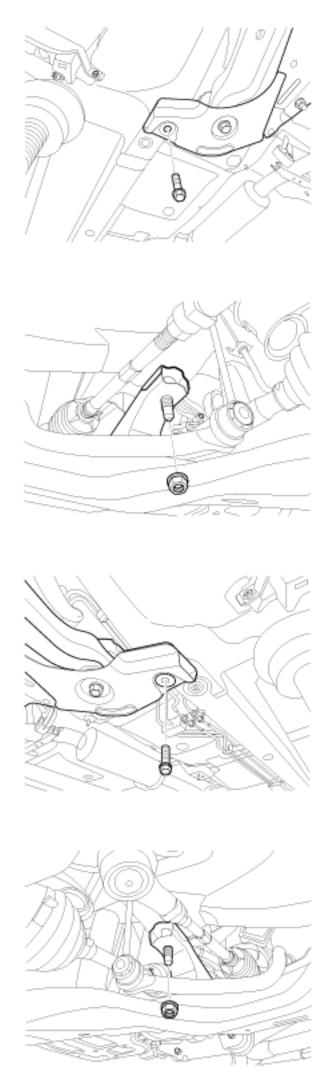


8. Remove the cross member (A) from the body by loosening the mounting bolts and nuts.

## Tightening torque:

160.0 ~ 180.0 Nm (16.0 ~ 18.0 kgf.m, 116.0 ~ 130.0 lb-ft)





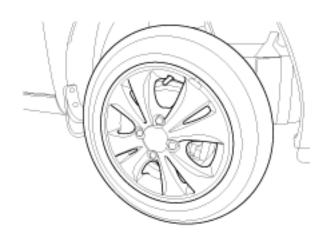
- Remove the steering gaer box.
   (Refer to Steering System "Steering Gear Box")
- Remove the front stabilizer bar.
   (Refer to Front Suspension System "Fornt Stabilizer Bar")
- Remove the front lower arm.
   (Refer to Front Suspension System "Front Lower Arm")



1. Remove the front wheel & tire.

### Tightening torque:

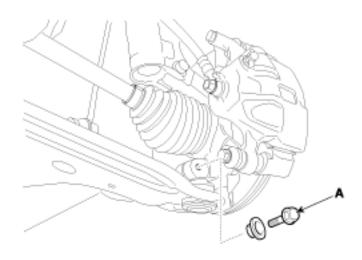
90.0 ~ 110.0 Nm (9.0 ~ 11.0 kgf.m, 65.0 ~ 80.0 lb-ft)



2. Loosen the bolts (A, B, C) and remove the lower arm.

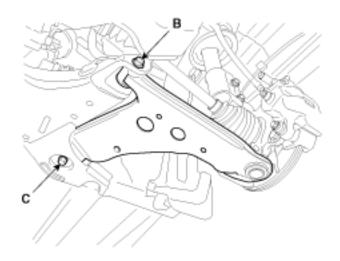
### Tightening torque:

A:  $60.0 \sim 72.0 \text{ Nm}$  ( $6.0 \sim 7.2 \text{ kgf.m}$ ,  $43.0 \sim 52.0 \text{ lb-ft}$ )



## Tightening torque:

B: 120.0 ~ 140.0 Nm (12.0 ~ 14.0 kgf.m,87.0 ~ 101.0 lb-ft) C: 100.0 ~ 120.0 Nm (10.0 ~ 12.0 kgf.m, 72.0 ~ 87.0 lb-ft)



3. Installation is the reverse of removal.

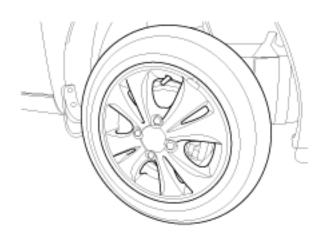
## NOTICE

Be careful not to damage the ball joint boot when installing the lower arm.

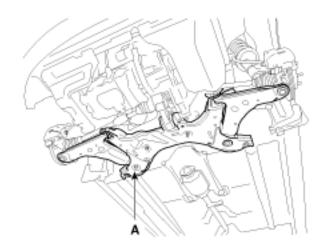
1. Remove the front wheel & tire.

### Tightening torque:

90.0 ~ 110.0 Nm (9.0 ~ 11.0 kgf.m, 65.0 ~ 80.0 lb-ft)



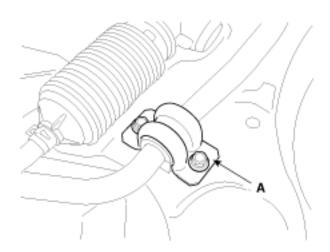
2. Remove the cross member (A) from the body. (Refer to Cross member)



3. Remove stabilizer from the cross member by loosening the bracket (A) mounting bolts.

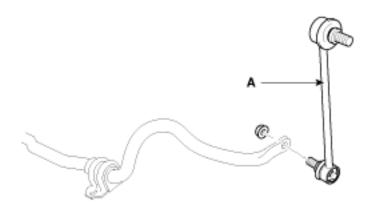
## **Tightening torque:**

45.0 ~ 55.0 Nm (4.5 ~ 5.5 kgf.m, 33.0 ~ 40.0 lb-ft)

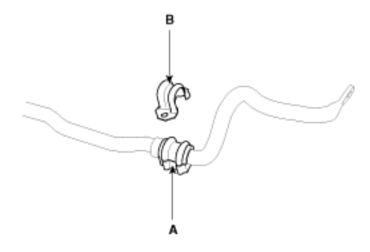


4. Disconnect the stabilizer link (A) with the stabilizer bar by loosening the nut.

### Tightening torque:



5. Remove the bushing (A) and the bracket (B) from the stabilizer bar.

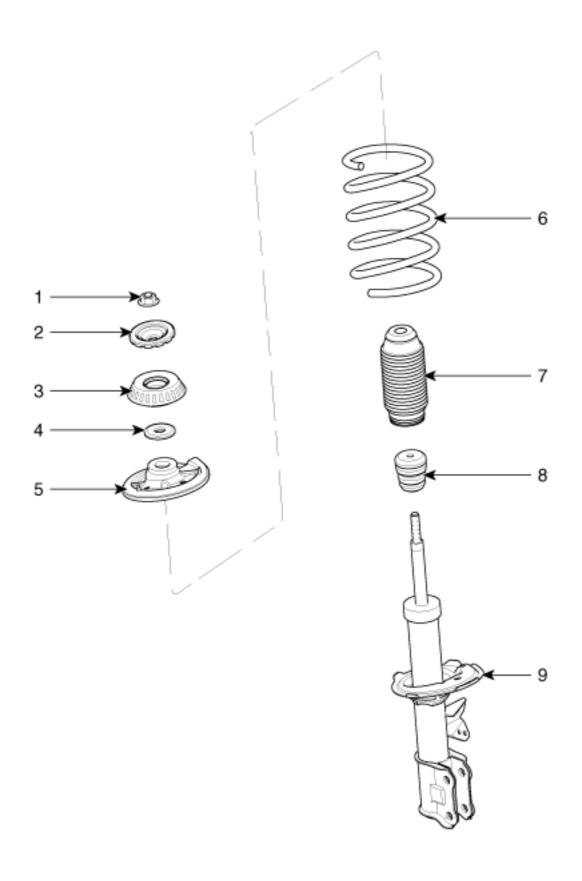


6. Installation is the reverse of removal.

## **INSPECTION**

- 1. Check the bushing for wear and deterioration.
- 2. Check the front stabilizer bar for deformation.
- 3. Check the front stabilizer link ball joint for damage.

## **COMPONENTS**



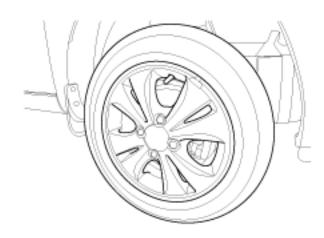
- 1. Lock nut
- 2. Insulator Dust cap
- 3. Strut insulator
- 4. Strut bearing
- 5. Spring upper seat

- 6. Coli spring
- 7. Dust cover
- 8. Bumper rubber
- 9. Shock absorber

1. Remove the front wheel & tire.

### Tightening torque:

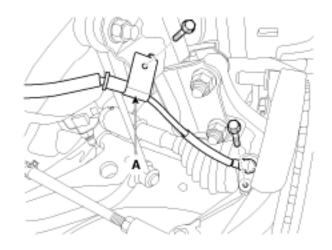
90.0 ~ 110.0 Nm (9.0 ~ 11.0 kgf.m, 65.0 ~ 80.0 lb-ft)



2. Remove the wheel speed sensor bracket (A) from the front strut assembly by loosening mounting bolts.

#### **Tightening torque:**

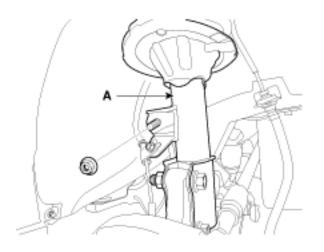
8.0 ~ 12.0 N.m (0.8 ~ 1.2 kgf.m, 6.0 ~ 9.0 lb-ft)



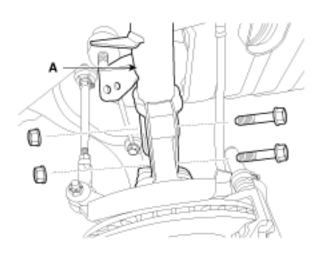
3. Disconnect the stabilizer link with the front strut assembly (A) after loosening the nut.

### Tightening torque:

50.0 ~ 65.0 N.m (5.0 ~ 6.5 kgf.m, 36.0 ~ 47.0 lb-ft)



4. Disconnect the front strut assembly (A) with the knuckle by loosening the bolt & nut.



5. Remove the cap (A) and then loosen the strut mounting nuts (B).





6. Installation is the reverse of removal.

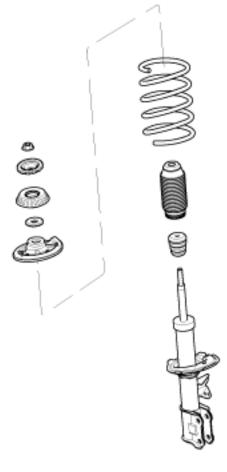
## **DISASSEMBLY**

- 1. Compress the coil spring with a strut spring compressor. Do not compress the spring more than necessary.
- 2. Loosen the lock nut.

#### **Tightening torque:**

 $50.0 \sim 60.0 \text{ Nm} (5.0 \sim 6.0 \text{ kgf.m}, 36.0 \sim 43.0 \text{ lb-ft})$ 

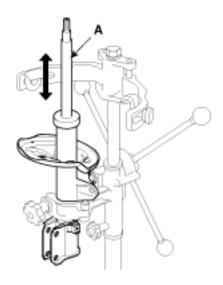
3. Disassemble the components of front strut assembly in sequence. (Refer to Front strut assembly components)



4. Reassembly is the reverse of disassembly.

## **INSPECTION**

- 1. Check the components for damage or deformation.
- 2. Compress and extend the piston rod (A) and check that there is no abnormal resistance or unusual sound during operation.



## **SPECIAL SERVICE TOOLS**

Tool (Number and Name)	Illustration	Use
09546-26000 Strut spring compressor		Compression of coli spring
09568-34000		Ball joint remover

## **SPECIFICATIONS**

## Front Suspension

Item		Specification	
Suspension type		MacPherson Strut	
Shook aboorbor	Typo	Gas	
Shock absorber	Type	Stabilizer bar	
Coil spring	K 1.0 MT K1.2 MT K1.2 MT LPG	318.0(12.51in) [GREEN - GREEN]	
	K 1.0 AT	330.1(12.99in) [GREEN - BLUE]	
	K 1.2 AT	330.1(12.99in) [GREEN - RED]	

## Rear Suspension

item			Specification		
Suspension type		ре	Torsion Axle		
Shock absorber	Туре		Gas		
		K1.0/1.2 TMK	299.1(17.77in) [GREEN-WHITE]		
Coil spring Free Height [I.D. color]	Free Height	K1.0/1.2 TMK&SUNROOF	308.0(12.12in) [GREEN-YELLOW]		
	K1.0/1.2 NON TMK	314.1(12.36in) [GREEN-GREEN]			
		K1.0 LPG	317.4(12.49in) [GREEN-BLUE]		

## Wheel and Tire

Item		Specification		
Tire		155/70R13		
		175/65R14		
		185/55R15		
	Steel	5.5JX14		
Wheel		4.08X13		
VVIICEI	Aluminum	5.5JX14		
		6.0JX15		
	155/70R13	2.6kgf/cm2 (36psi)		
	175/65R14	2.2kaflam2 (22nai)		
Tire pressure	185/55R15	2.3kgf/cm2 (33psi)		
	T115/70D15	4.2kgf/cm2 (60psi)		

## Wheel Alignment

Item		<u> </u>				
		Fron	it		Rear	
Toe-in	Total	0.16°±0.2°		0.3°(+0.5°/-0.3)		
roe-m	Individual	0.08°±	0.1°	0.1	15°(+0.25/-0.15)	
Cambe	er angle	-0.5°±0	).5°		-1.5°±0.5°	
Caste	r angle	3.76°'±	0.5°		-	
King-pi	in angle	14.2°±	0.5°		-	
Ride	height	344±10 (13.54in0.3937in)		(13	353±10 (13.89in0.3937in)	
Tightening torques Front Suspension						
		Tig	htening torq	ue (kgf.ı	m)	
Item		Nm	kgf.m		lb-ft	
Hub nuts		90.0 ~ 110.0	9.0 ~ 11.0		65.0 ~ 80.0	
Strut assembly to wheel hous	sing penal	50.0 ~ 60.0	5.0 ~ 6.0		36.0 ~ 43.0	
Strut assembly to knuckle		100.0 ~ 120.0	10.0 ~ 1	2.0	72.0 ~ 87.0	
Strut assembly lock nut		60.0 ~ 75.0	6.0 ~ 7	.5	43.0 ~ 54.0	
Stabilizer link to strut assemb	ly	50.0 ~ 60.0	5.0 ~ 6	.5	36.0 ~ 47.0	
Lower arm to sub frame (Fror	nt)	120.0 ~ 140.0	12.0 ~ 1	4.0	87.0 ~ 101.0	
Lower arm to sub frame (Rea	r)	100.0 ~ 120.0	10.0 ~ 1	2.0	72.0 ~ 87.0	
Lower arm to knuckle		60.0 ~ 72.0	6.0 ~ 7	6.0 ~ 7.2		
Stabilizer bar to stabilizer link		50.0 ~ 60.0	5.0 ~ 6	.5	36.0 ~ 47.0	
Stabilizer bracket mounting bolts		45.0 ~ 55.0	4.5 ~ 5	.5	33.0 ~ 40.0	
Cross member to body		160.0 ~ 180.0	16.0 ~ 1	8.0	116.0 ~ 130.0	
Rear roll stopper through bolt & nut		50.0 ~ 65.0	5.0 ~ 6	.5	36.0 ~ 47.0	
Tie rod end castle nut		24.0 ~ 34.0	2.4 ~ 3	.4	17.0 ~ 25.0	
Universal join to pinion of steering gear (MNL)		13.0 ~ 18.0	1.3 ~ 1	.8	9.4 ~ 12.3	
Universal join to pinion of steering gear (EPS)		33.0 ~ 38.0	3.3 ~ 3	.8	24.0 ~ 27.0	

**Specification** 

lb-ft

65.0 ~ 80.0

16.0 ~ 23.0

72.0 ~ 87.0

 $36.0 \sim 43.0$ 

 $72.0 \sim 87.0$ 

Rear Suspension			
ltom	Tig	htening torque (kgf.	m)
Item	Nm	kgf.m	

90.0 ~ 110.0

22.0 ~ 32.0

100.0 ~ 120.0

50.0 ~ 60.0

100.0 ~ 120.0

 $9.0 \sim 11.0$ 

2.2 ~ 3.2

10.0 ~ 12.0

 $5.0 \sim 6.0$ 

10.0 ~ 12.0

# Hub nuts

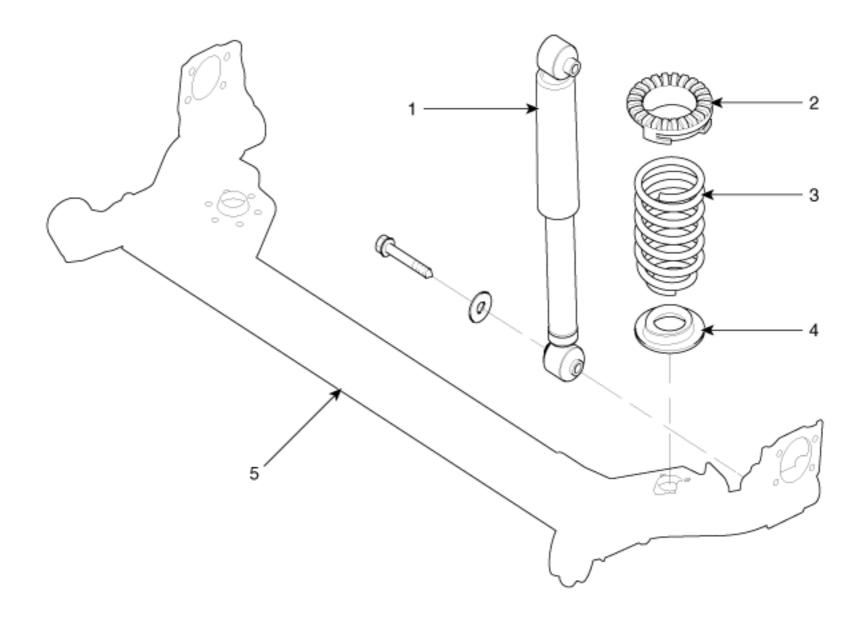
Shock absorber to body

Carrier to torsion beam

Shock absorber to carrier

Bitmap Torsion beam to body

## **COMPONENTS LOCATION**



- 1. Rear shock absorber
- 2. Spring upper pad
- 3. Coil spring

- 4. Spring lower pad
- 5. Torsion beam axle

1. Remove the rear wheel & tire.

### Tightening torque:

90.0 ~ 110.0 Nm (9.0 ~ 11.0 kgf.m, 65.0 ~ 80.0 lb-ft)



- 2. Support the lower portion of the torsion axle with a jack.
- 3. Remove the cover (A), (B) and then loosen the nuts (C). **[LH]**







[RH]







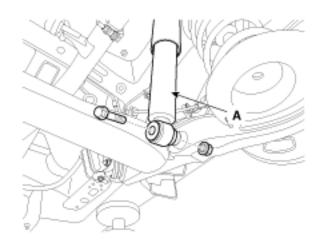
4. Loosen the bolt (A) and then remove the rear shock absorber (B) from the torsion beam axle.



5. Loosen the bolt & nut and then remove the rear shock absorber (A) from the torsion beam axle.

## **Tightening torque:**

100.0 ~ 120.0 Nm (10.0 ~ 12.0 kgf.m, 72.0 ~ 87.0 lb-ft)



6. Installation is the reverse of removal.

## **INSPECTION**

- 1. Check the components for damage or deformation.
- 2. Compress and extend the piston and check that there is no abnormal resistance or unusual sound during operation.

1. Remove the rear wheel & tire.

### Tightening torque:

90.0 ~ 110.0 Nm (9.0 ~ 11.0 kgf.m, 65.0 ~ 80.0 lb-ft)



2. Remove the rear brake caliper assembly (A) and then suspend it with wire.



3. Remove the rear hub & carrier assembly by loosen the mounting bolts.

## **Tightening torque:**

65.0 ~ 75.0 Nm (6.5 ~ 7.5 kgf.m, 47.0 ~ 54.0 lb-ft)





4. Remove the Parking brake cable clip (A) and loosen the bracket bolts (B).

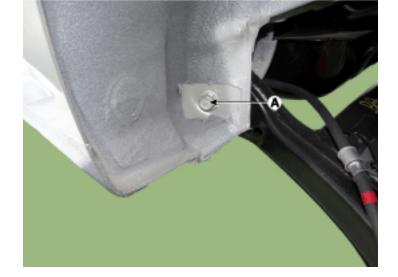




## NOTICE

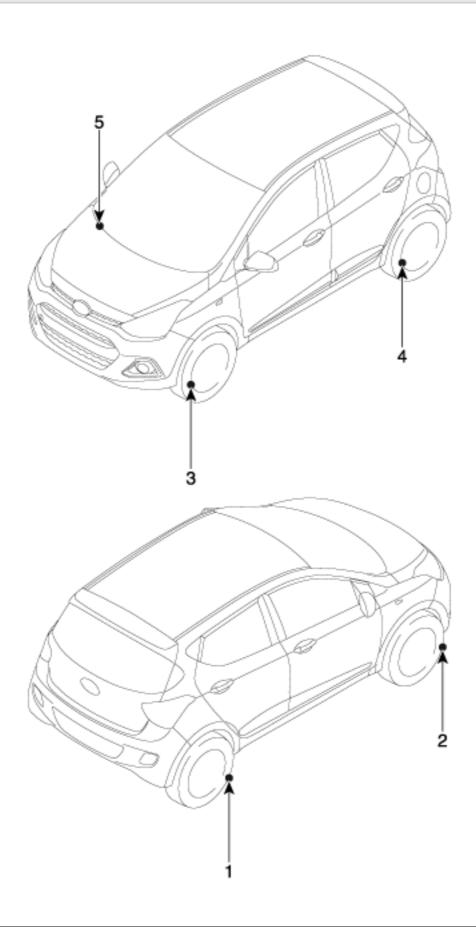
Be careful not to damage the parking brake cable by wheel speed sensor mounting bracket.

- Remove the rear shock absorber.(Refer to Rear Suspension System "Rear Shock Absorber")
- 6. Remove the torsion beam axle from the body loosening the mounting bolt (A).



7. Installation is reverse of the removal.

## **COMPONENTS LOCATION**



1.	TF	PMS	sensor	(RR)
----	----	-----	--------	------

<sup>2.</sup> TPMS sensor (FR)

3. TPMS sensor (FL)

4.	<b>TPMS</b>	sensor	(RL)
			` '

5. Receiver

#### **DESCRIPTION**

## **Tread Lamp**

- Tire Under Inflation / Leak Warning.



- 1. Turn on condition
  - · When tire pressure is below allowed threshold
  - When rapid leak is detected by the sensor.
- 2. Turn off condition
  - Under-inflation; When tire pressure is above (warning threshold + hysteresis).
  - Rapid Leak; When tire pressure is above (leak warning threshold).

### Wheel Location

- 1. Turn on condition
  - At the same time as TREAD Lamp.
  - Indicates wheel location where under inflation / leak has occurred.
- 2. Turn off condition
  - At the same time as TREAD Lamp.

### NOTICE

If wheel locations change in between Ignition cycles, then the system assumes the previous Auto-Located position. Once Auto-Location completes on the current Ignition cycle, the correct lamp will be lit.

## **DTC Warning**

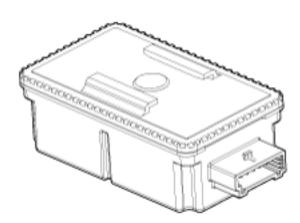
- 1. Turn on condition
  - When the system detects a fault that is external to the receiver / sensor.
  - When the system detects a receiver fault.
  - When the system detects a sensor fault.
- 2. Turn off condition
  - If the fault is considered as 'critical', then the lamp is held on throughout the current Ignition cycle (even if the DTC has been demoted). This is because it is important to bring the problem to the drivers attention. On the following Ignition cycle, the demotion conditions will be re-checked. If the demotion conditions occur, the lamp will be turned off. It will be held on until DTC demotion checking is completed.
  - 'Non critical' faults are those that can occur temporarily e.g. vehicle battery under voltage. The lamp is therefore turned off when the DTC demotion condition occurs.

## System Fault

- 1. General Function
  - The system monitors a number of inputs across time in order to determine that a fault exists.

- Faults are prioritized according to which has the most likely cause.
- Maximum fault store is equal to 15.
- Certain faults are not covered through DTC. The main ones are:
  - a. Receiver Micro-controller lock up ; requires observation of lamps at Ignition ON to diagnose.
  - b. Ignition Line stuck; requires observation of lamps at Ignition ON to diagnose.

#### **DESCRIPTION**



#### 1. Mode

#### (1) Virgin State

- The receiver as a sole part is shipped in this state. Replacement parts should therefore arrive in this state.
- In this state, there is no sensor monitoring and no DTC monitoring.
- The state indicates that platform specific parameters must be written to the receiver and that sensors are un-learned.

## (2) Normal State

- In order for tire inflation state and DTC monitoring to occur, the receiver must be in this state.
- In this state, automatic sensor learning is enabled.

#### (3) Test State

• This state is only used in manufacturing plant to check RF transmission between sensor and receiver.

#### 2. Overview

- · Receives RF data from sensor.
- Uses sensor data to decide whether to turn on TREAD Lamp.
- · Learn TPM sensor for under inflation monitoring automatically.
- Uses sensor information, distance travelled, background noise levels, Auto-learn status, short / open circuit output status, vehicle battery level, internal receiver states to determine if there is a system or a vehicle fault.

#### **OPERATION**

## 1. General Function

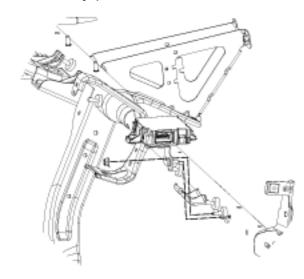
- Auto-learn takes place only once per Ignition cycle.
- On successful completion, 4 road wheel sensor ID's are latched into memory for monitoring.
- Until Auto-learn completes, previously learned sensors are monitored for under inflation / leak warnings.

#### 2. General Conditions to Learn New Sensors:

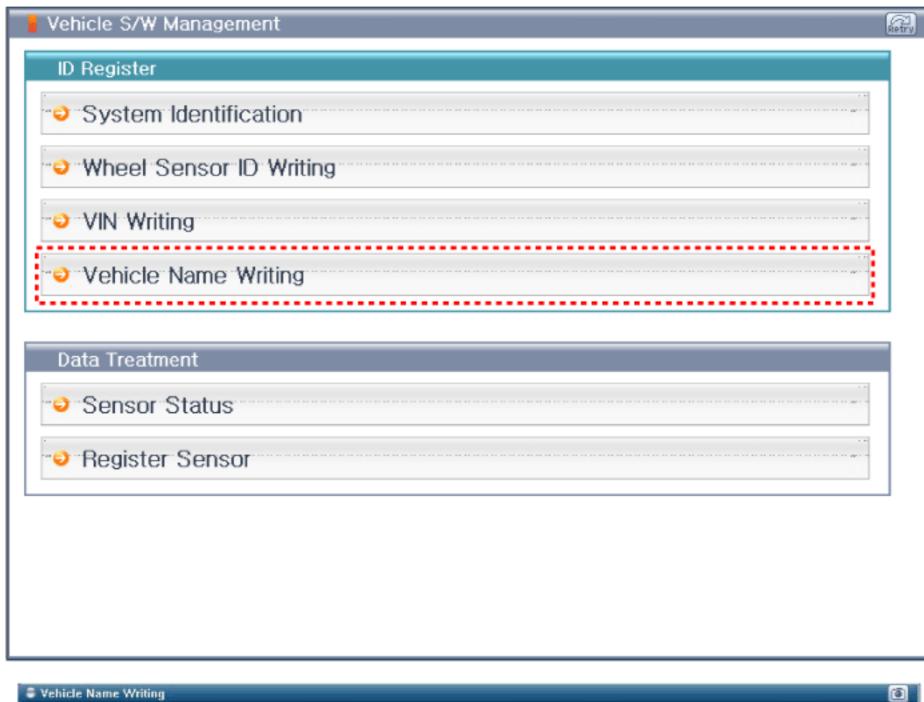
Receiver must determine that it is confident that sensor is not temporary:

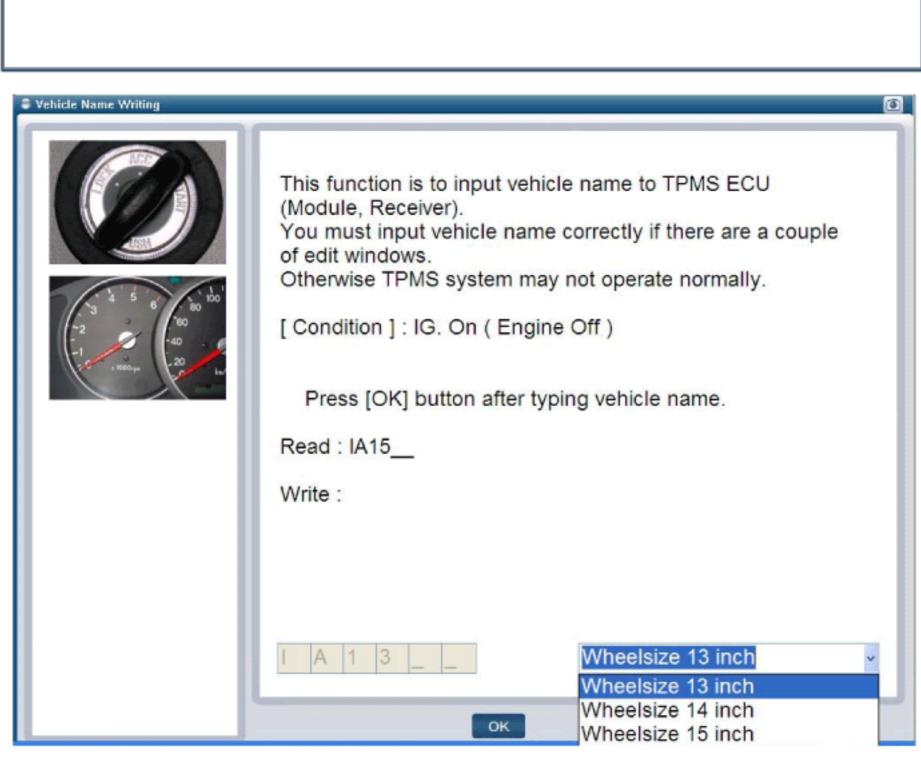
- a. Uses vehicle speed.
- b. Uses confidence reduction of previously learned sensors.
- Typical time at driving continuously over 15.5 mph(25 kph) to learn a new sensor is up to 20 minutes.
- 3. General Conditions to Un-Learn a sensor that is removed:
  - It takes less than 20 minutes at 15.5 mph(25 mph).
  - Confidence reduction is dependent on time which vehicle is driven at speed greater than or equal to 12.4 mph(20 kph).

- 1. Disconnect the negative (-) battery cable.
- Remove the glove box.(Refer to Body "Crash Pad")
- 3. Remove faulty part and fit bracket assembly to new part.

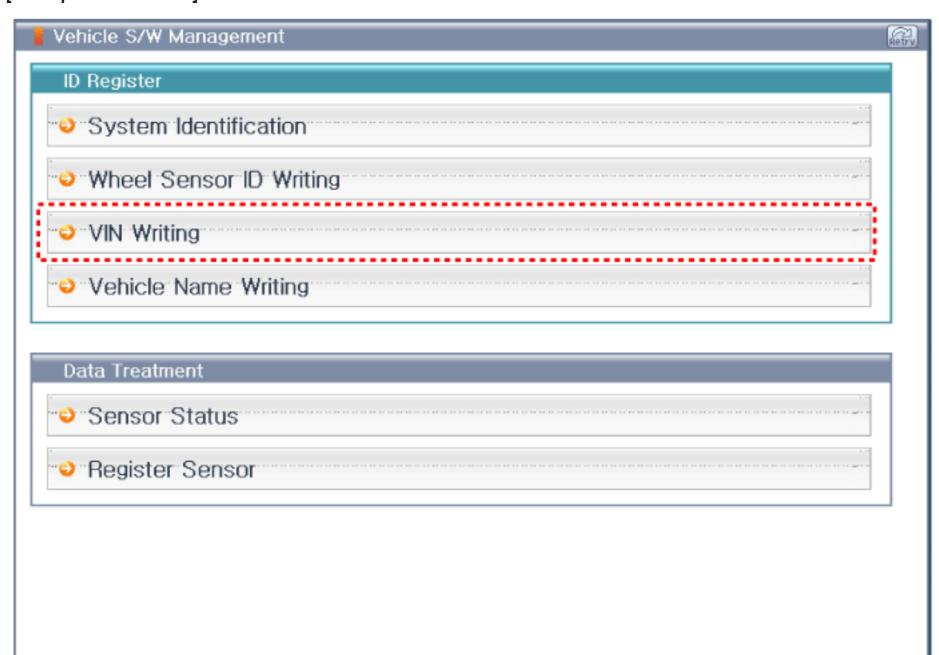


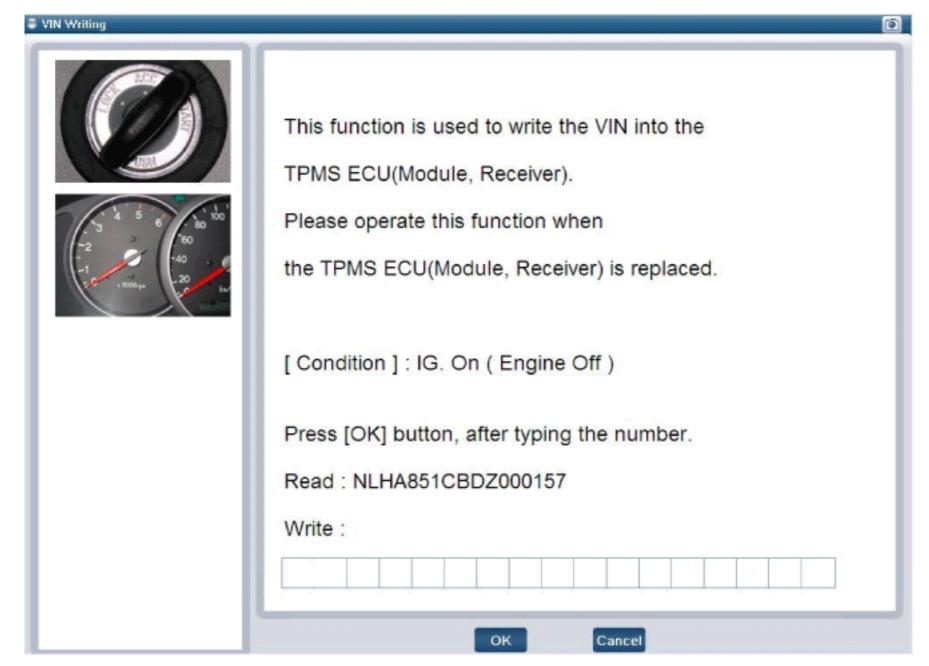
- 4. Secure new part to vehicle and fit connector.
- 5. Re-connect battery and turn Ignition on.
- 6. After replacing the receiver, learn by using self-diagnosis device(GDS). **[Vehicle name input initialization]**



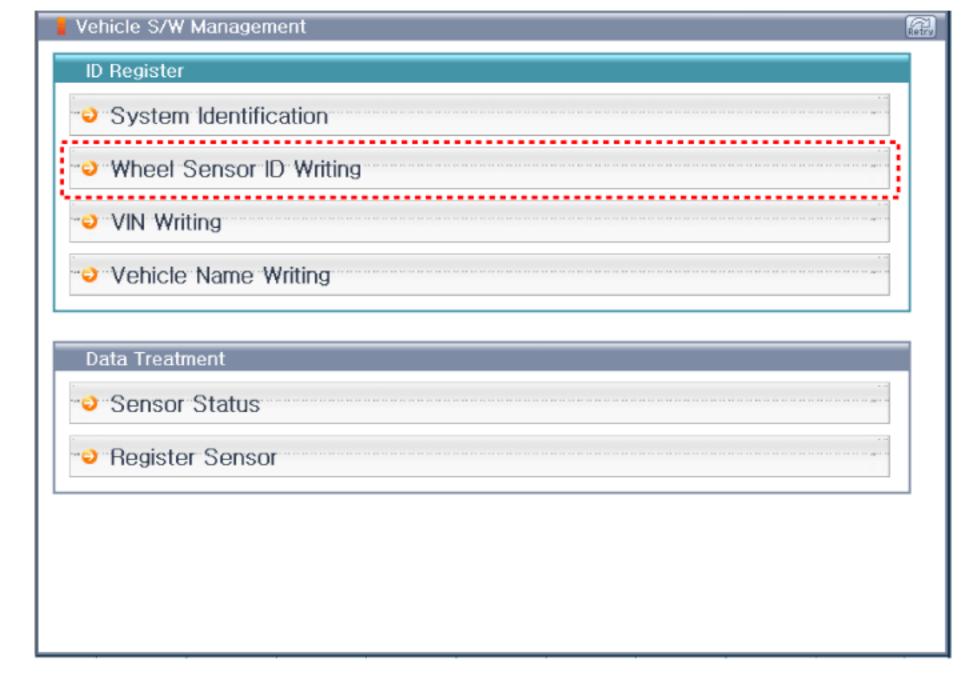


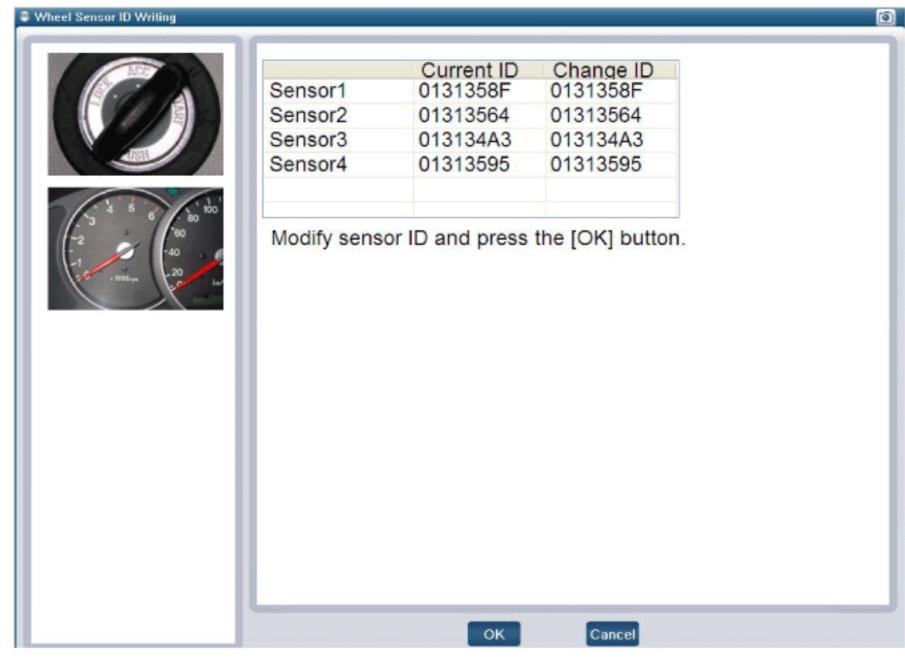
## [VIN input initialization]





[Wheel Sensor ID Writing (Wireless) initialization]





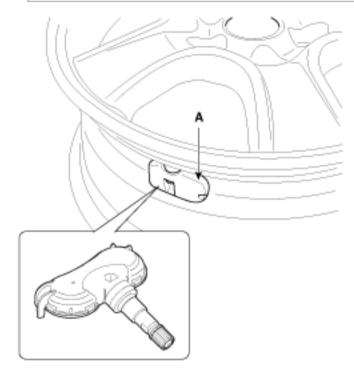
Repair tire after using the Tire Mobility Kit (TMK)

## When the TPMS warning lamp OFF

- 1. Remove the tire, wheel and TPMS sensor.
- 2. Remove the sealant on the wheel and TPMS sensor (A) completely.

## **▲** CAUTION

- Clean the sealant on the housing and sensing hole of TPMS sensor with clean cloth, gauze or air inhalers.
- To prevent the sensor and circuit board damage, do not use the pointed instrument and give a lot of impact.



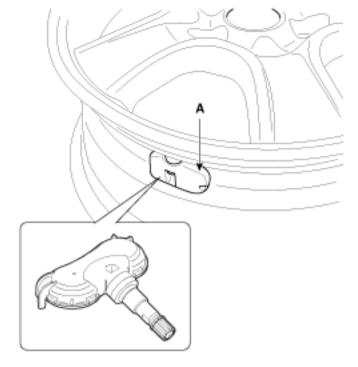
- 3. Install the TPMS sensor to the new tire.
- 4. Check that the normal operation of TPMS system.

## When the TPMS warning lamp ON

- 1. Remove the tire, wheel and TPMS sensor.
- 2. Remove the sealant on the wheel and TPMS sensor (A) completely.

## **▲** CAUTION

- Clean the sealant on the housing and sensing hole of TPMS sensor with clean cloth, gauze or air inhalers.
- To prevent the sensor and circuit board damage, do not use the pointed instrument and give a lot of impact.



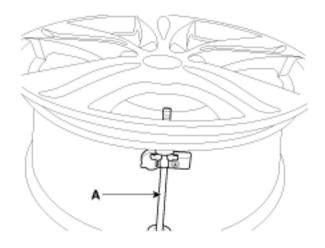
- 3. Install the TPMS sensor to the new tire.
- 4. Check the tire pressure using the electrical tire pressure gauge.
- 5. Check the tire pressure of TPMS sensor using the GDS
- 6. If the difference between two checked pressures in the above is not more than 2 psi, TPMS sensor is normal. Reinstall it to new tire.
- 7. If the difference between two checked pressures in the above is more than 2 psi, TPMS sensor is abnormal. Install new TPMS sensor to new tire.
- 8. Check that the normal operation of TPMS system.

## **REMOVAL**

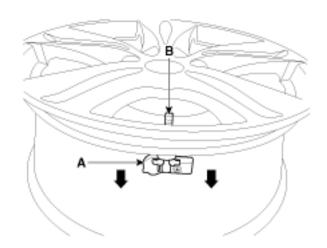
- Remove the tire.
   (Refer to Tires/Wheels "Tire")
- 2. Remove the screw with torx driver (A).

## **▲** CAUTION

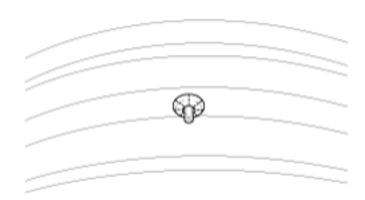
- When installing the bead brake, make sure that it does not come in contact with the TPMS sensor.
- Be careful not to damage the TPMS sensor when installing the bead brake near the TPMS sensor.



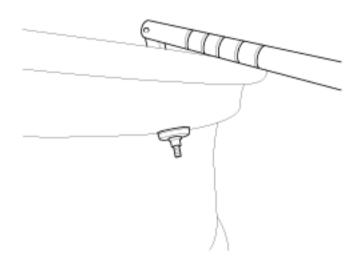
3. Remove the sensor body (A) from the valve (B) in the direction of the arrow.



- 4. Remove the valve using the valve mounting tool.
  - (1) Cut the rubber at the bottom of valve with a knife.



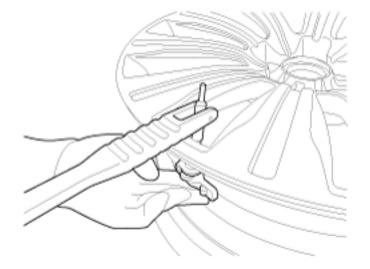
(2) Use the valve mounting tool to pull out the valve until it is entirely out of the lower hole.



5. Apply lubricant to the surface of the valve, and then mount it through the valve hole of the wheel.

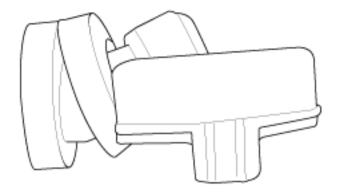
## NOTICE

We recommend using regular soapy water as lubricant.

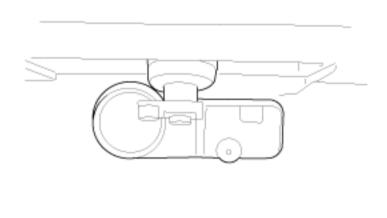


## **▲** CAUTION

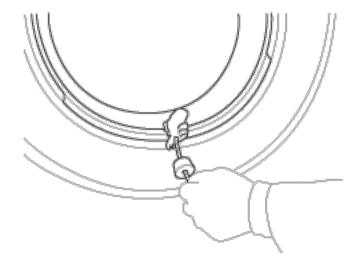
• The TPMS sensor valve bottom is not properly sealed if it is not fully mounted on the wheel, as shown in the following figure:



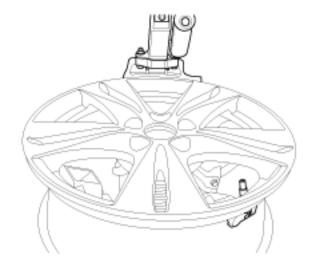
• Make sure that the valve body is pulled entirely through the hole.



6. Apply soapy water or lubricant to the upper/lower bead section of the tire.



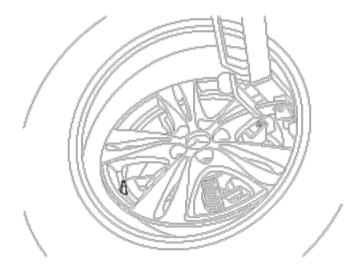
7. In order to mount lower the beads, place the TPMS sensor at 5 o'clock, starting from the head of the tire replacement equipment.



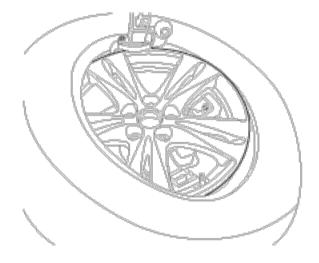
8. Rotate the rim clockwise and press tire towards 3 o'clock to mount the lower beads.

# **▲** CAUTION

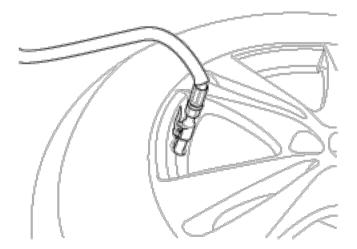
• Mount the tire on the wheel. Make sure that the beads touch the edge of the rim behind the sensor (towards 6 o'clock).



9. In order to mount the upper beads, press the tire towards 3 o'clock and turn the rim clockwise.



10. Inject air into the tire until the beads are in the correct position.



- 11. Adjust the tire pressure according to the recommended tire pressure for the vehicle.
- 12. If the TPMS sensor malfunctions, you must perform TPMS sensor learning. Replace any faulty sensors and perform TPMS sensor learning.

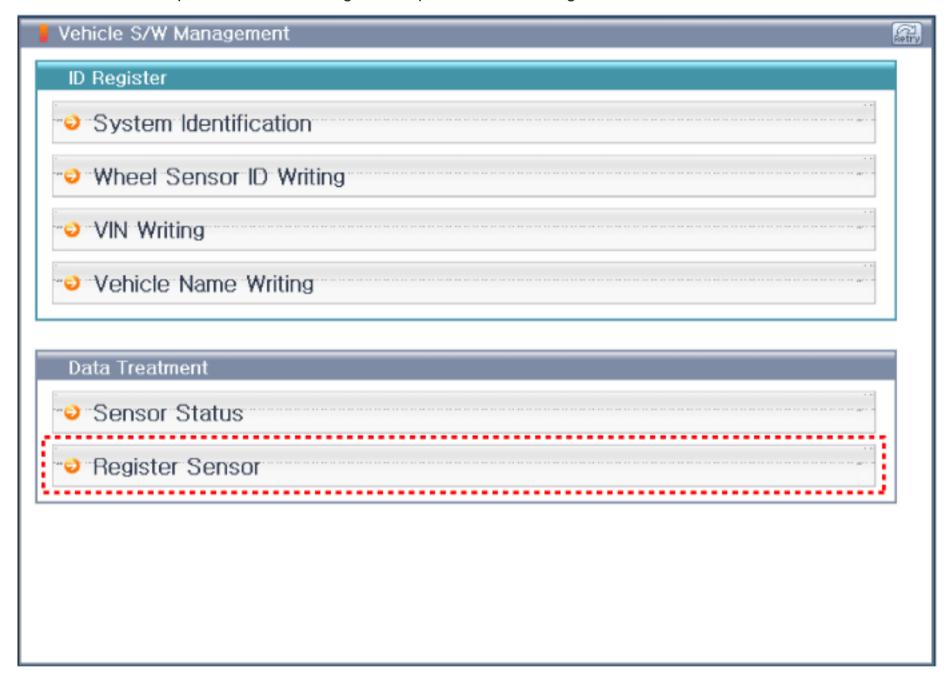
## **ADJUSTMENT**

## [Sensor Registraion]

## NOTICE

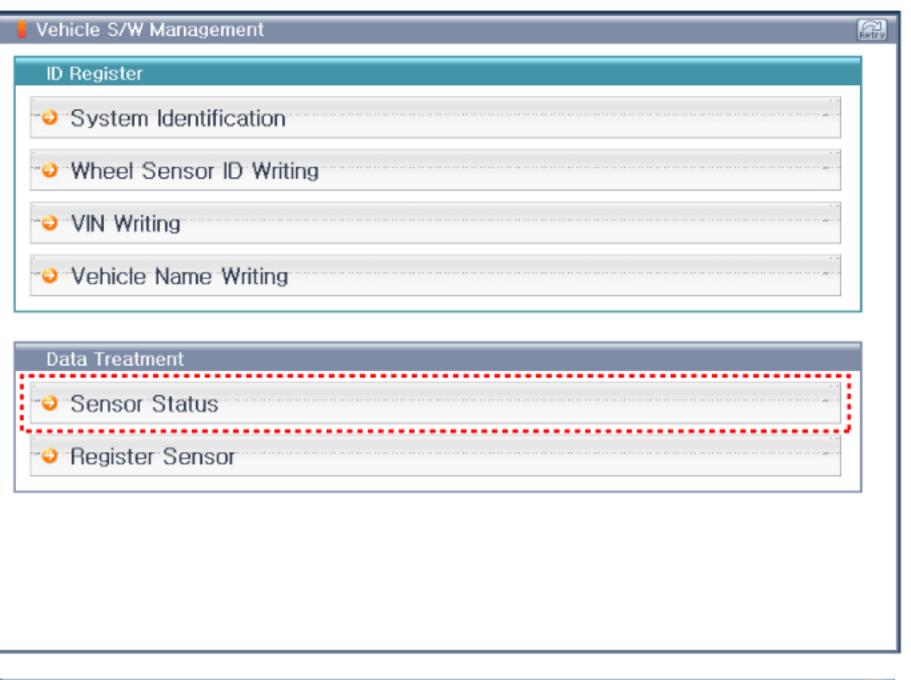
If the sensor registration procedure is not performed by GDS after replacing the TPM sensor or Receiver, TPMS is not operated.

- 1. Install GDS (Global Diagnostic System) and GDS TPMS module to vehicle.
- 2. Select the model and perform the sensor registration procedure according to instruction of the GDS as follows.





[Sensor Status initialization]



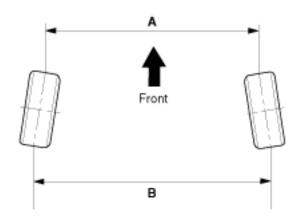


## FRONT WHEEL ALIGNMENT

## **NOTICE**

When using a commercially available computerized wheel alignment equipment to inspect the front wheel alignment, always position the vehicle on a level surface with the front wheels facing straight ahead. Prior to inspection, make sure that the front suspension and steering system are in normal operating condition and that the tires are inflated to the specified pressure.

## Toe



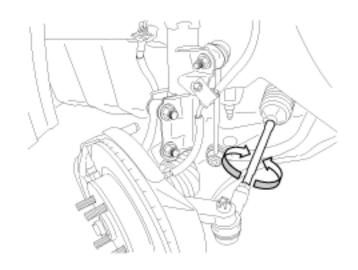
B - A > 0: Toe in (+) B - A < 0: Toe out (-)

## Toe adjustment

- 1. Loosen the tie rod end lock nut.
- 2. Remove the bellows clip to prevent the bellows from being twisted.
- 3. Adjust the toe by screwing or unscrewing the tie rod. Toe adjustment should be made by turning the right and left tie rods by the same amount.

#### Toe

Total: 0.16°±0.2° Individual: 0.08°±0.1°



4. When completing the toe adjustment, install the bellows clip and tighten the tie rod end lock nut to specified torque.

### **Tightening torque:**

50.0 ~ 55.0 Nm (5.0 ~ 5.5 kgf.m, 36.0 ~ 40.0 lb-ft)

Camber and Caster are pre-set at the factory, so they do not need to be adjusted. If the camber and caster are not within the standard value, replace or repair the damaged parts and then inspect again.

Camber: -0.5°±0.5° Caster: 3.76°±0.5°

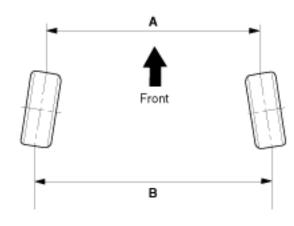
### **REAR WHEEL ALIGNMENT**

## NOTICE

When using a commercially available computerized wheel alignment equipment to inspect the rear wheel alignment, always position the vehicle on a level surface.

Prior to inspection, make sure that the rear suspension system is in normal operating condition and that the tires are inflated to the specified pressure.

# Toe



B - A > 0: Toe in (+) B - A < 0: Toe out (-)

Toe is pre-set at the factory, so it does not need to be adjusted. If the toe is not within the standard value, replace or repair the damaged parts and then inspect again.

#### Toe

Total:  $0.3^{\circ}(+0.5^{\circ}/-0.3)$ 

Individual: 0.15°(+0.25/-0.15)

#### Camber

Camber is pre-set at the factory, so it does not need to be adjusted. If the camber is not within the standard value, replace or repair the damaged parts and then inspect again.

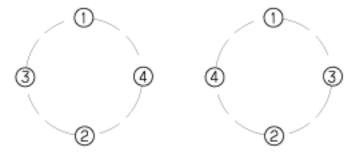
**Camber :** -1.5°±0.5°

# **HUB NUT TIGHTENING SEQUENCE**

Tighten the hub nuts as follows.

## Tightening torque:

90.0 ~ 110.0 Nm (9.0 ~ 11.0 kgf.m, 65.0 ~ 80.0 lb-ft)



# NOTICE

When using an impact gun, final tightening torque should be checked using a torque wrench.

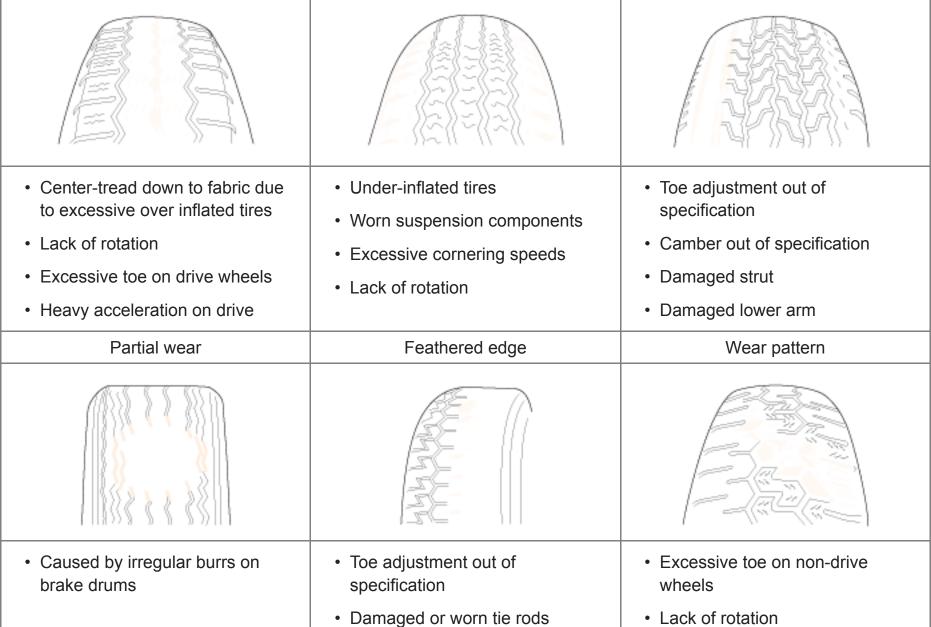
## **TROUBLESHOOTING**

Symptom	Possible cause	Remedy
Hard steering	Improper front wheel alignment Excessive turning resistance of lower arm ball joint Low tire pressure No power assist	Correct Replace Adjust Repair and replace
Poor return of steering wheel to center	Improper front wheel alignment	Correct
Poor or rough ride	Improper front wheel alignment Malfunctioning shock absorber Broken or worn stabilizer Broken or worn coil spring Worn lower arm bushing	Correct Repair or replace Replace Replace Replace Replace the lower arm assembly
Abnormal tire wear	Improper front wheel alignment Improper tire pressure Malfunctioning shock absorber	
Wandering	Improper front wheel alignment Poor turning resistance of lower arm ball joint Loose or worn lower arm bushing	Correct Repair Retighten or replace
Vehicle pulls to one side	Improper front wheel alignment Excessive turning resistance of lower arm ball joint Broken or worn coil spring Bent lower arm	Correct Replace Replace Repair
Steering wheel shimmy	Improper front wheel alignment Poor turning resistance of lower arm ball joint Broken or worn stabilizer Worn lower arm bushing Malfunctioning shock absorber Broken or worn coil spring	Correct Replace Replace Replace Replace Replace Replace
Bottoming Broken or worn coil spring Malfunctioning shock absorber		Replace Replace

Wheel /tire noise, vibration and harshness concerns are directly related to vehicle speed and are not generally affected by acceleration, coasting or decelerating. Also, out-of-balance wheel and tires can vibrate at more than one speed. A vibration that is affected by the engine rpm, or is eliminated by placing the transmission in Neutral is not related to the tire and wheel. As a general rule, tire and wheel vibrations felt in the steering wheel are related to the front tire and wheel assemblies. Vibrations felt in the seat or floor are related to the rear tire and wheel assemblies. This can initially isolate a concern to the front or rear.

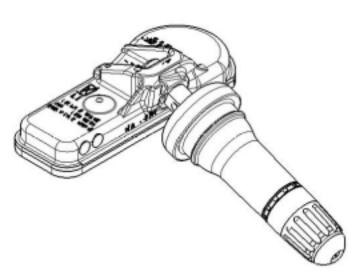
Careful attention must be paid to the tire and wheels. There are several symptoms that can be caused by damaged or worn tire and wheels. Perform a careful visual inspection of the tires and wheel assemblies. Spin the tires slowly and watch for signs of lateral or radial runout. Refer to the tire wear chart to determine the tire wear conditions and actions

Wheel and tire diagnosis					
Rapid wear at the center	Rapid wear at both shoulders	Wear at one shoulder			



Damaged knuckle

### **DESCRIPTION**



#### **Function**

- 1. Tire pressure, Temperature, Acceleration, Battery voltage measurement
- 2. RF (Radio Frequency) Transmit (Tire pressure, Temperature, Acceleration, Battery voltage, Sensor ID, Sensor Status information.)

#### **OPERATION**

## **Operating mode**

1. Factory Mode

The factory mode is the mode that allows the TPMS sensor to transmit RF Frames and sample LF more often in the HKMC factory. The TPMS sensor will send normal RF frames in factory mode.

LF sampling will occur every 1 second, to ensure a rapid response on the production line.

Factory mode is not a normal mode; it operates over the other customer visible modes to increase the LF sampling rates while the factory counter is not Zero.

On leaving Off mode the factory counter will be set to 15, each time the sensor moves from Service mode to stationary mode, the counter will be decremented.

After Factory mode has expired, the Factory\_LF command can be used to re-enter Factory mode, in which case the factory counter will be reset to 15.

If Factory mode is no longer required, it is possible to reset the factory counter, and therefore exit Factory mode by using the Exit\_Factory\_LF command.

During 10.8s mode, the sensor will transmit normal RF data frames every 10.8s. In case of high line sensor, the function code will indicate rotational direction.

2. Stationary Mode

In normal operation and while the vehicle is not moving the TPMS Sensor will be in STATIONARY mode. In this mode sample and transmission rates are described below.

3. Auto Learn Mode & Auto Location Mode

Upon detection of motion, an Unknown / Normal function code is transmitted, then the sensor enters AL Mode (Auto Learn Mode) or ALO Mode (Auto Location Mode), depending on TPMS sensor type (Lowline or Highline). During AL mode, the sensor will continue to transmit Unknown/Normal function codes every 33 seconds for a duration of 16 RF Blocks (1 RF block = 4 RF frames).

During ALO mode the TPM sensor begins to determine which direction the sensor is rotating - clockwise or anticlockwise. For the first transmission after the Unknown / Normal function code, the data block will contain one of three function codes for ALO Mode. If the ASIC is unable to make a decision concerning rotational direction, then the sensor shall transmit an Unknown / Normal function code.

During AL/ALO Mode the shock sensors are sampled for motion, every 10.8 seconds. The pressure and temperature samples also occur every 10.8 seconds. The transmission rate and duration of AL/ALO Mode is set to a one block transmission (4 frames) rate every 33 seconds for a duration of 16 blocks. In ALO Mode rotational direction is acquired every 10.8 seconds. The transmitted function code is based on all ALO data since its last transmission. The AL/ALO mode function flag will be set for the transmission of all valid AL/ALO frames.

If the speed of the vehicle drops below the stationary threshold and the sensor detects that there is no motion present, then AL/ALO Mode will be exited and Service Mode will be entered. If Service Mode exits due to detection of motion and AL/ALO Mode is re-entered then the AL/ALO Mode continues where it left off i.e. the total AL/ALO duration of 16 blocks is achieved regardless if Service Mode or Alert Mode has been entered during that AL/ALO Mode.

#### 4. Service Mode

Service Mode is the period when the TPMS sensor has detected that the vehicle speed has dropped below the stationary threshold. During this period the pressure and temperature and motion samples occur every 15 seconds but there are no transmissions, the TPMS sensor will only transmit on a pressure change, DP. The DP transmission will consist of two blocks (Total of 8 frames) of pressure information transmitted over a two second period. The duration of Service Mode is 15 minutes from when the TPMS sensor has detected that there is no rolling detection. If during Service Mode rolling detection is detected again, the sensor will exit Service Mode and re-enter the mode it was previously in before it entered Service Mode, AL Mode or Normal Mode. Every time Service Mode is entered the 15-minute timer is reset. If Service Mode is exited before the Service Mode timer expires then the AL Mode counter will not be reset. Upon expiration of Service Mode the AL Mode counter is reset.

### 5. Rolling Mode

When AL Mode expires the TPM sensor enters Rolling Mode. In Rolling Mode the rate of transmissions and rolling detection sampling are decreased to once every 60s and the rate of pressure and temperature sampling occur every 15 seconds. For the first 16 blocks of transmissions after a drive begins the TPM sensor transmits the AL Mode function codes Clockwise, Anticlockwise or Normal/Unknown. After the 16 blocks of AL information have been transmitted, the TPM sensor will transmit the Normal/Unknown function code. If the speed of the vehicle drops below the stationary threshold and the TPM sensor detects that there is no rolling detection present, then Rolling Mode will be suspended and Service Mode will be entered.

On entry to Rolling mode the TPM sensor will sample pressure and do a normal RF transmission with a NORMAL/UNKOWN function code

When vehicle speed has dropped below minimum vehicle speed threshold, the sensor will remain in Rolling mode until the next scheduled rolling detection sample occurs. Once the rolling detection sample has confirmed the vehicle speed is below the threshold, the TPM sensor will enter Service Mode. After the Service Mode period has elapsed the TPM sensor will exit to STATIONARY Mode.

#### 6. Alert Mode

In Stationary mode, Service Mode or Rolling mode, pressure is measured at intervals as described above. During the measurement routine the current pressure value is compared to the previous transmitted pressure value. If the current pressure sample differs by greater than 8 counts (>2 psi ) or more from the previous transmitted pressure value, a RE-MEASURE will occur immediately to ensure the sample is correct. If a delta P is confirmed the TPM Sensor will transmit immediately with an Alert status code. If the RE-MEASURE transmission occurs coincident with a regular transmission, the RE-MEASURE takes precedence and the regular transmission will be replaced by the RE-MEASURE transmission.

#### 7. Stationary Alert Mode

While the sensor is in Stationary Mode, it shall transmit an instantaneous measured data frame, as defined in Section 4.1 of this document, if a pressure change of 2.0 psi from the last transmission or greater has occurred. All transmissions occurred due to a pressure change event shall have the Alert status code as specified in below table. Stationary Alert mode will be exited if a change in pressure of 2.0p.s.i. or greater is not detected after 2 consecutive pressure samples.

Pressure Sample Rat (seconds)  Temperature Sample Rate(seconds)		Rolling detection Sample Rate (seconds)	Normal Tx Rate (Seconds)	
2 (max)	2 (max)	N/A	ΔΡ	

### 8. Rolling Alert Mode

While the sensor is in Rolling Mode, it shall transmit an instantaneous measured data frame. if a pressure change of 2.0p.s.i. or greater from the last transmission or greater has occurred All transmissions occurred due to a pressure change event shall have the Alert status code as specified in below table.

Rolling Alert mode will be exited if a change in pressure of 2.0p.s.i. or greater is not detected after 2 consecutive pressure samples.

Pressure Sample Rat (seconds)	Temperature Sample Rate(seconds)	Rolling detection Sample Rate (seconds)	Normal Tx Rate (Seconds)	
2 (max)	2 (max)	N/A	ΔΡ	

#### 9. OFF Mode

This is a mode primarily used for shipping and storage of the TPM sensor units. When the sensor is de-energized (using the Enter\_Off LF command), it shall transmit one last transmission with the Off Mode function code then enter the Off Mode immediately. When the TPM sensor is in Off Mode, it shall continue sampling pressure and temperature at the rate specified in Table 13 of this document but it shall not transmit any transmission until the TPM sensor is reenergized again.

The TPM sensor can be re-energized using the Normal LF command or when it detects a change in pressure of 19p.s.i. or greater.

#### 10. RF Test Mode

The sensor must enter the RF Test Mode and provide the state code specified in upon the presence of an LF signal with the LF data command "Test\_LF" specified in Table below.

The sensor must react (Transmit and provide data) no later than 700.0 ms after the LF data code has been detected. As soon as the sensor enters this mode it shall comply with all the sampling and transmission requirements specified, regarding this specific mode independent of rotating, stationary, or service mode.

The sensor shall count the number of frames (each transmission contains four frames as shown in Table below) it has transmitted since it entered this Mode, and this number shall be transmitted within the data in each frame as shown in Table below.

The Data transmitted shall be in the format shown in Table below. When the counter for the number of frames reach the value 255 (All of the 8 bits are used), the counter shall reset and restart again until the sensor exits this mode. When the sensor exits this mode it shall clear the number of frames counter. The sensor shall exit this mode upon the presence of a Normal\_LF command as specified.

The sensor shall start an eight hours timer from the moment it enters this mode and then shall exit this Mode immediately after the eight (8.0) hours' timer expires.

Pressure Sample Rat (seconds)	Temperature Sample Rate(seconds)	Rolling detection Sample Rate (seconds)	Normal Tx Rate (Seconds)	
15 (max)	15 (max)	15 (max)	15 (max)	

RF Test Mode Data Structure = Fram 1 = Fram 2 = Fram 3 = Fram 4						
Preamble	H/L Bit	ID	Pressure	No. of Frames	Status	CRC
16 bits	1 bit	31 bits	8 bits	8 bits	8 bits	8 bits

#### 11. Continuous Wave (CW) Mode

The TPM sensor must enter the specified CW Mode when it receives the appropriate LF data command ( CW\_Low\_LF or CW\_High\_LF ).

The TPM sensor must react (Transmit) no later than 200.0 ms after the LF data code has been detected. As soon as the sensor enters this mode it shall start transmitting the specified CW frequency (Carrier Wave Frequency) of the TPM sensor.

There are 2 CW modes available:

- CW Low will transmit continuously at the lower FSK frequency.
- CW High will transmit continuously at the upper FSK frequency.

The sensor shall exit this mode upon the presence of a Normal\_LF command.

The sensor shall start a four minutes timer from the moment it enters this mode and then shall exit this Mode immediately after the four (4.0) minutes timer expires.

## **TIRE WEAR**

1. Measure the tread depth of the tires.

Tread depth [limit]: 1.6 mm (0.063 in)

2. If the remaining tread depth (A) is less than the limit, replace the tire.

# NOTICE

When the tread depth of the tires is less than 1.6 mm(0.063 in), the wear indicators (B) will appear.

